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ABSTRACT

Designed to be used as a supplementary teaching aid for subjects such as science, social studies, and environmental education, this packet of modules contains materials related to waste and waste management for secondary level students. Each of the eight modules consists of a teacher's page, background information, references, questions, projects, and activities. Module titles include: (1) "Resources and Wastes" (providing an overview to waste management and production); (2) "Waste Streams" (focusing on wastes produced in domestic and industrial streams); (3) "Waste Management" (reviewing management practices); (4) "Wastes Costs" (explaining costs of wastes); (5) "Resource Recovery" (focusing on the costs, benefits, barriers, and incentives associated with resource recovery); (6) "Roles, Responsibilities, and Legislation" (identifying legal factors); (7) "Consumer Choices" (exploring the consumers' decisions and effects of these decisions); and (8) "Getting Involved" (outlining specific ways of reducing wastes and improving management practices). A separate teaching guide is also provided which contains suggestions for use and points out additional references, periodicals, and audiovisual materials. (ML)

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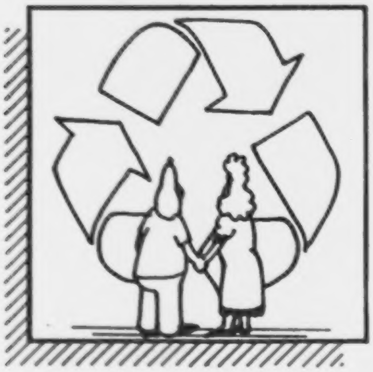
RESOURCES AND WASTES
IN-SERVICE PACKAGE
FOR
VOLUNTEER WORKSHOP
LEADERS



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BC
Ministry of Environment and Parks

SE 048 180

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I - NOTES TO VOLUNTEER WORKSHOP LEADERS

Your role as a workshop leader is to help teachers familiarize themselves with the "Resources and Wastes" environmental education package, so that they can help students better understand the complex problems associated with the management of wastes in our society.

The purpose of this paper is to provide you with guidelines for the preparation and delivery of a workshop to introduce "Resources and Wastes" to teachers in your district. Use those points which best suit your style and the particular needs of the group.

Workshops can provide opportunities for making new friends, sharing new ideas, learning new teaching strategies and exchanging new information. We can deal with new issues, new experiences, new approaches to problems and solutions.

Workshop leaders who engage in old methods for their workshops may be unable to meet today's challenge of competing for teachers' attention and time. I am not suggesting you discredit all old methods associated with workshops you have attended in the past, but use only the best ideas to enhance the experience for meeting old friends, and to work with other teachers who have a devotion to the education of young people.

The workshop leader can help the group make its own observations, interpretations and conclusions. Individual participants can share their skills and experience with other members of the group.

All workshops have both content -- that is, "what" information you wish to share -- and process, which is "how" you deliver this information to meet the goals of your workshop. The content may vary somewhat depending on whether the audience is made up of teachers of consumer education, science, and technology, or a group with diversified subject areas but a commitment to environmental education. The process will depend in part on your particular style and how you determine the following:

The goals and objectives of the program and the workshop

The purpose of the workshop

. Attitude . Knowledge . Skill Development

. Content . Teaching Strategies

Who will use the material? How?

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It is important to know exactly what is the purpose of your session. Begin by writing the following goals in your own words (feel free to add and/or delete):

- To familiarize teachers with the environmental education package Resources and Wastes.
- To develop a strategy for using the materials on Monday morning.
- To identify the curriculum match for the program.

You will need a definite plan in mind before you begin the workshop. Outline this plan in an agenda which you will share with the group. This will provide both you and the participants with a clear understanding of what they will be able to do and what will be accomplished in the allotted time.

Two options are: to have a set agenda with a time for accepting revisions at the start; or, to make a working agenda ahead of time, and to review topics to be covered and accept recommendations from the group as part of the pre-registration procedures.

Introduce yourself and state your expectations for the workshop. This is your first opportunity to establish rapport. Call people by their first names. This is much easier if you use "interesting" name tags wherever possible.

Since you have mainly a voluntary group, it is a good policy to learn a bit about the expectations and needs of the group. There will obviously be different points of view on "What" should be done, "How" things should be done, and "What" problems will be solved. The group will realize that you cannot address everyone's concerns and problems today; however, you have consulted with them and are concerned about meeting their needs and have adjusted your workshop to meet the majority needs.

You now have the goals and objectives for your workshop clearly understood and have started the interaction between yourself and the group. Your next step is to plan the body or pathway to meeting these goals and objectives. Decide where participants are in relation to where you want them to be. Ideally, you need to know what they know about the topic of waste management and if they are familiar with the educational package Resources and Wastes. The entry behaviour of teachers will vary depending on their area of expertise, philosophy toward environmental education, and general interest.

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You always know more than there will be time to introduce; you will have to select from the wealth of information, keeping in mind the needs expressed by the participants and their level of expertise. Also, it is dangerous to over-estimate your participants' knowledge of waste management.

Primary information on the topic of waste management is both necessary and useful to teachers. Decide on the content participants **must know, should know,** and **could know.** You will need to allow for a breathing space to allow individuals the opportunity to assimilate the most important points and to vary the pace of your workshop.

The process or "how" you give the information will include a **start, goal, pathway or body, closure, evaluation.** "How" you begin and end the workshop is as important as how you achieve your objectives and goals.

A general overview of the content, using overheads, can be one way of serving the needs of a diversified group. One group may see the content as a review of a topic they are familiar with, and another may see it as an introduction to new concepts and information.

Questions, questions, questions--their questions! If you can help your participants to think out the answers themselves, you may find new ways of adjusting and adapting the program to fit into existing curriculum.

Questions. If you can't answer them, make a note and tell them you will find out the answer and send the information. Feel free to contact the Ministry to answer questions related to waste management or environmental education.

Arrange a time at the end of the day's program to briefly discuss and evaluate the activities.

Evaluation forms have been provided in the package; which can help the Ministry to continue to provide quality programs, and provide you with feedback on your workshop.

To assist you in planning your workshop, the following information has been attached to this paper: checklists for planning the workshop, a working agenda with a list of suitable activities for workshop, and a log for the video tape "Garbage Is Resource Full"; and a sample lesson plan form. Adopt, innovate, and enjoy yourself in this sharing experience.

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LONG RANGE CHECKLIST FOR PLANNING A WORKSHOP

a) Decide on focus of workshop.
b) Prepare a tentative agenda.
c) Identify who will be eligible to participate--subject area or level.
d) Secure a workshop location which has:
  - large room for group session
  - tables for group interaction
  - food services available
  - parking space
  - access to office equipment and telephone
e) Find a volunteer to host and coordinate arrangements of (d) above and secure publicity.
f) Construct a budget. Include items such as equipment rentals and "Resources and Wastes". Include costs of food and beverages.
g) Determine methods of attracting potential participants.
h) Pre-registration can help:
  - identify the number of people who will be attending
  - identify their understanding of the topic
  - identify grade and subject area
  - indicate type of clothing suitable for workshop
  - provide a working agenda
i) Prepare registration forms. Limit 20 people per session. **(Decide on feasibility of workshop.)**
j) Order "Resources and Wastes" and instructional materials well ahead of time.
k) Prepare a schedule, keeping in mind:
  - total number of participants
  - number of assistants needed
  - number of rooms and space needed
  - materials needed
  - refine agenda for workshop
l) Line up speakers, films, and/or field trips.
m) Check with personnel on mealtimes and menus. Consider potluck lunch, snack or catering. Arrange for beverages during the session.
n) Make a list of necessary equipment:
  - screens
  - projectors
  - overhead
  - chalkboard
  - writing materials
  - "Resources and Wastes" (one per participant)
  - video "Garbage Is Resource Full"
  - display

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LONG RANGE CHECKLIST FOR PLANNING A WORKSHOP (Cont'd)

o) Consider potential problems such as illness or bad weather that can change session. Arrange for assistants to notify participants on short notice of change in plans.
p) Order support material and display, if necessary, from Ministry of Environment and Parks, Information Services Branch.
q) Collect your student projects for display.

CHECKLIST FOR SHORT RANGE PLANNING OF WORKSHOP

a) Prepare final list of participants.
b) Prepare and plan workshop.
c) Inform workshop participants of the purpose of the workshop and what is expected of them well in advance. Identify materials participants should bring to a workshop. Consider pre-registration.
d) Mail a package of material to each participant, including:
  - maps
  - schedules
  - list of fellow participants
  - preparatory reading, e.g. refer to curriculum guides.
e) Notify hosts and staff of final number of participants.
f) Prepare all materials such as charts, flip charts, overheads, laboratory and art supplies.
g) Set up learning materials.
h) Assign someone to run registration and supply beverages on day of workshop.
i) Prepare name tags.
j) Become thoroughly familiar with materials to be presented, and practice presentation.
k) Assign someone to collect and summarize workshop evaluations.
l) Collect the materials required for the workshop, as follows:
  - agenda
  - Glossary of Waste Management Terms
  - overheads and overhead masters
  - one educational package "Resources and Wastes" per participant
  - video "Garbage Is Resource Full"
  - evaluation forms
  - registration enrollment list.

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CHECKLIST FOR DAY OF WORKSHOP

a) Put up signs, i.e. meeting rooms, dining areas and learning stations.
b) Display a copy of agenda.
c) Check with personnel on schedules for food and beverages.
d) Make sure display materials are visible and labelled.
e) Make sure audiovisual materials are working properly.
f) Make sure seating arrangements reflect purpose of sessions (tables for small groups--chairs for lecture).
g) When you have broken into small groups, arrange for reporters in each group to record ideas.

DAY OF WORKSHOP

Checklist Aids

a) Pencils, paper
b) "Resources and Wastes" packages
c) Special equipment, overhead projector, videotape recorder
d) Prepared visuals, flip chart, overhead plates, videotape
e) Name tags
f) Handouts, evaluation forms, etc.
g) Adequate chairs

DAY AFTER WORKSHOP

Checklist

a) Write up brief report on workshop.
b) Include those lesson plans, strategies for use, or suggestions for updating that you would like to see included in future reprints.
c) Send report, enrollment list, invoice and evaluation forms to the Ministry of Environment and Parks, Information Services Branch, 810 Blanshard Street, Victoria, B.C., V8V 1X5, Attention: M. Miiller.

II - WORKING AGENDA

USE THIS WORKING AGENDA TO HELP YOU DEVELOP THE WORKSHOP AND PLAN YOUR AGENDA

1. INTRODUCTION

Introduce yourself and the program.

What is "Resources and Wastes"?

This is a Teacher's Resource Book which provides a complete guide to a unit of study on waste management, resource conservation, and resource recovery for use by secondary school teachers.

The program will assist students to understand the hidden costs associated with the production, consumption and disposal of goods, and provides opportunities for them to learn how to make consumer decisions based on that understanding.

It is a flexible modular program which includes a comprehensive teacher's guide, additional resources, lists of complementary A.V. resources, current facts and statistics and projects, activities and questions to help students understand the current issues related to waste, pollution, resource recovery, and resource conservation.

How was it developed and who was involved?

It was developed with the cooperation and assistance of a group of teachers, the Ministry of Education and specialists from the Ministry of Environment and Parks.

Why was it developed?

To help students understand the complex issues, problems and trade-offs associated with managing waste from the production and disposal of goods no longer wanted by society.

To introduce students to research and problem solving.

Who is it for?

Secondary teachers. This resource book is a valuable lesson aid for teachers in the following areas: Science, Geography, Consumer Education, Outdoor Education, Family Management, Health, Home Economics, Law, Science and Technology, and Language Arts.

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Note: a) Science and Technology teachers will receive a complimentary copy of "Resources and Wastes" with the teacher module for "Waste Technologies By-Product" from the Ministry of Education. All other educators must purchase the package from the Ministry of Environment and Parks.

b) "Resources and Wastes" also reflects the Consumer Education goals, in particular, the following:

i) to help students make and evaluate consumer decisions based on their values and goals while appreciating the affect of their choices on the environment; and
ii) to analyze and assess the responsibility of the consumer to conserve and reduce or prevent pollution.

2. GOALS (State goals, review agenda, assess needs of group)

What is the purpose of the workshop?

To introduce teachers of consumer education to the environmental education package "Resources and Wastes", and to provide support for the highest interest groups in districts already supporting environmental education.

To collect information and share ideas.

To encourage the use of "Resources and Wastes" in existing courses.

What are the goals of the workshop?

To become familiar with the contents of "Resources and Wastes".

To develop a strategy for using "Resources and Wastes" and/or develop a lesson plan.

- Program content
- Understanding the problem
- Working towards solutions
- Curriculum match

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What are the goals of Resources and Wastes?

To develop a better understanding of the issues, problems and solutions associated with waste management, especially in the areas of pollution, recycling and resource recovery.

To introduce students to problem solving and research.

To encourage students to use their basic skills learned in language arts, biology, consumer education, social studies and the physical and natural sciences to explore their interrelationship with the environment.

To reduce waste and explore methods for disposing of goods no longer wanted or needed by society at this time.

What are the participant's needs?

[Ask participants what their needs are for todays workshop and list on a flip chart or blackboard. You may want to adapt your agenda at this point.]

[You may want to hand out the self-test "How Do You Stackup" contained in the teacher's guide of "Resources and Wastes" and discuss briefly.]

3. PROGRAM OVERVIEW

What are the major issues currently facing individuals, industry and elected officials regarding waste management?

Some questions which can be answered by the learner exposed to "Resources and Wastes".

- What is a resource?
- What is waste?
- Where does it come from?
- What happens to the goods no longer wanted by society?
- What problems does waste create? (e.g. pollution, landfill siting, disposal, recycling, resource recovery)
- What can we do?

Note: Refer to overheads to briefly outline the content of the program.

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4. FORMAT AND DESIGN

How does the format and design encourage teachers to add to the package and continue updating?

[Hand out manuals and give teachers an opportunity to thumb through the manual before the coffee break.]

COFFEE BREAK

5. VIEW VIDEOTAPE "GARBAGE IS RESOURCE FULL" (24:30 minutes)

Preview the videotape using the attached program log. This tape is included in the teacher module "Waste Technologies By-Product", Science and Technology 11. The tape is available on loan from the Ministry of Environment and Parks, Information Services Branch, 810 Blanshard Street, Victoria, B.C., V8V 1X5, and also may be purchased from the Provincial Educational Media Centre, 7351 Elmbridge Way, Richmond, B.C., V6X 1B8.

Video Summary

"Garbage Is Resource Full" uses a lively style to present basic statistics on waste and recycling in B.C. It identifies causes of the current problems facing waste managers, types of waste, and the approaches being taken to deal with these problems. A strong theme of the video is individual responsibility for managing the amount of garbage being produced, concluding with the statement: "The choice is up to you."

This video is entertaining and appropriate for most students. It is too lengthy for convenient classroom presentation, but could be stopped when the focus shifts from presenting the problem to suggestions for positive actions (see Program Log). The rest of the video could be used in Extension Activity 3.03: Recycling Domestic Waste. The technical quality of the imagery is not high but is adequate. The data is relatively current and related specifically to B.C.

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Program Log

Time in Minutes (approx.)	Segment Description
00:00	The video opens with a song and some statistics to emphasize the volume of garbage generated by our "throw-away" society. Waste is a problem because of our attitudes, technology, and large population.
04:00	Waste is described as solid, liquid, and gas. Kinds of waste are domestic, industrial, and special. All sectors of society generate waste.
06:00	Waste management techniques include sanitary landfills and safe disposal of special wastes. We need to decrease the use of valuable energy used to haul away our garbage and replace what we throw away.
08:30	A "recipe" demonstrates ways to reclaim what we've used by illustrating recycling processes.
10:00	Stop tape at this time, and complete Core Activity 1.03.
10:00	We can become more discriminating consumers by discouraging overpacking and waste. Time and rethinking will contribute to recycling.
13:00	The narrator dissects the components of a camera to illustrate the resource used to take a photograph.
18:00	The video presents examples of ways that government, industry, and service clubs are contributing to recycling. It also suggests how individuals can help to control waste.
23:00	The four R's of resource management are reduce, reuse, recycle, and rethink. The best way to control waste is not create it.
25:00	Stop tape.

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6. QUESTIONS, PROJECTS AND ACTIVITIES

How will students come to their own conclusions regarding the complex issues, problems and solutions associated with waste management?

[Have participants break into groups selected on the basis of interest, grade level, or subject area. The group selects a recorder and spokesperson for their group.

Assign one of the following activities from the "Resources and Wastes" program. The following activities have been chosen because they can be completed in a limited amount of time, and require minimal preparation for you, the workshop leader.

Module 1	Overview Resources and Wastes	- No. 1, 2
Module 2	Waste Streams	- No. 3, 4
Module 3	Waste Management	- No. 4
Module 4	Waste Costs	- No. 2, 3
Module 5	Resource Recovery	- No. 7
Module 6	Roles, Responsibilities and Legislation	- No. 3, 6, 9
Module 7	Consumer Choices	- No. 7
Module 8	Getting Involved	- No. 9

Should you have additional preparation time you may wish to consider one of the suggested field trips. Please note, Module 2 - Waste Streams No. 5, which involves sampling water, has an additional fee attached. The Environmental Laboratory charges $50.00 for sampling equipment and analysis.

Briefly discuss the activities done by each group.]

7. DEVELOP A STRATEGY FOR USING "RESOURCES AND WASTES"

How does "Resources and Wastes" fit into the existing curriculum?

[Develop a strategy for using "Resources and Wastes" Monday morning in the classroom. Share this information with the group.]

Note: Appendix I --a suggested lesson plan format for your possible use.

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8. EVALUATION

How can the Ministry of Environment and Parks assist educators in promoting environmental education and updating the educational package "Resources and Wastes"?

How can I improve my skills as a workshop leader?

[Hand out the evaluation forms]

9. PRIOR CONSIDERATIONS

Some prior considerations you may find useful in designing your workshop.

Teachers Need:

- basic information--general content ideas (refer to overheads)
- good introduction
- motivation, initial interest, and involvement
- video "Garbage Is Resource Full"
- "Resources and Wastes" package - one per participant (district or participant purchase one package per person before workshop)
- means of identifying value to teachers of "Resources and Wastes" workshop, i.e. rationale for workshop.
- Glossary of Waste Management Terms

GOOD LUCK AND ENJOY YOURSELF!

III - GLOSSARY OF WASTE MANAGEMENT TERMS

absorb - to take up and completely assimilate a substance

acid rain - any rain fall which is more acidic than usual. It results from emissions of nitrogen oxides and sulphur compounds which are released into the air.

Act - a provincial or federal law

additive - a substance added to another in relatively small amounts to impart or improve desirable properties or suppress undesirable properties

advertising - messages designed to encourage purchase, use or consumption of a product or service

afterburners - a device in an incinerator to burn undesirable gases produced in the first combustion stage

bag filters - a fabric mesh used to remove fine particles from incinerator gases before they are exhausted to the environment through the smokestack

base stock - a substance which contains the primary properties necessary for the final product's use

benefits - the positive impacts of an activity or investment which contribute to an improvement in condition

biochemical oxygen demand (BOD) - the amount of oxygen in water used by bacteria to live

biodegradable - any material, natural or synthetic, which can be broken down by micro-organisms

black liquors - a chemical liquid waste which is a by-product of the pulping process

by-law - a law of local application (eg, municipal law)

by-product - another substance in the course of making the first one (eg, a secondary product which is produced as a result of a biological or industrial process)

carcinogenic - cancer causing to humans and animals

carrying capacity - an ecosystem's ability to sustain its dependent population

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catalytic converters - devices used on automobile exhaust systems which chemically combine hydrocarbons and carbon monoxide to form more harmless carbon and water

compost - relatively stable decomposed organic material, often used for soil enrichment

consumers - 1. animals in an ecosystem which consume plant or other animal life
2. people who buy goods or services for their own use and not for resale or for production of other goods for resale: as opposed to producers

contaminant - a foreign substance which often adds undesirable properties to the source material

costs - negative impacts of an activity or investment resulting in net losses

curbside pickup - the collection of recyclable materials from the curb beside one's home

cyclone collectors - can be used to reduce the levels of particulate in gaseous emissions

decomposers - micro-organisms in an ecosystem which break organic material down into its basic elements

direct costs - straightforward payment for the purchase of a product or service

diversion credits - funds provided which reflect the value of diverting some materials from the waste stream

domestic waste stream - includes all of the wastes generated by individuals at home, school and work. These can be divided into four major categories, solid, liquid, gaseous, and special wastes

ecosystem - a natural system consisting of plant and animal life which provides its own food chain

effluent - 1. something that flows out
2. a discharge to the environment of previously-treated liquid wastes

electrostatic precipitator - a device which cleans pollutants from smokestack emissions

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end-user - the final person or agency who obtrains and makes use of a material

eutrophication - a process in which the life-sustaining quality of a body of water is lost or reduced

fly ash - small solid particles of ash which enter the gas stream when burning coal, oil or waste materials

food chain - the cycle in which plant and animals are consumed in an ecosystem starting with micro-organisms and ending with carnivores

greenhouse effect - a phenomenon which results when increased levels of carbon dioxide in the atmosphere cause an increase in the earth's temperature. The carbon dioxide layer in the upper atmosphere acts like the glass in a greenhouse: it lets the sunlight through to the surface while trapping the heat radiated by the earth.

guidelines - a set of rules or limits which are suggested, or which set a recommended standard

hazardous waste - any wastes which because of its nature requires special control

high grade paper - good quality paper typically with long fibre construction valuable as a recyclable material

hog fuel - wood wastes consisting of chips, bark, small branches and other wood material

impermeable - the quality of preventing one substance from passing through another

incinerator - a plant designed to reduce waste volume by combustion, with or without energy recovery

indirect costs - 1. costs which are not included in the price of a product
2. hidden payment for a product or service made indirectly through taxes or price increases

inert - the quality of not reacting chemically or physically with other substances

intangible - not capable of being touched or felt; in economic terms, it implies that no dollar value can be attributed to something

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ionizing radiation - any radiation that displaces electrons from atoms or molecules, thereby producing ions or electrically charged atomic particles

landfill - a system of trash and garbage disposal in which the waste is buried between layers of earth to build up low lying land

leachates - 1. liquid which has picked up dissolved materials after percolating through another material
2. liquid that has percolated through solid wastes and/or been generated by solid waste decomposition and which has extracted, dissolved or suspended materials in it. This liquid may contaminate ground or surface water if not properly controlled.

market place - the broad term used to describe the component of the trading system in which goods and services are exchanged

needs - the basic requirements to sustain life

neutralize - to treat a substance to make it chemically neutral or harmless

non-renewable - resources which are available only in infinite quantities, such as minerals and oils

nutrients - substances which are required to promote growth living plants and organisms, primarily nitrogen and phosphorus

organic - derived from living organisms, including most natural materials which easily decompose or dissolve into the environment

packaging - a commodity's wrapping or sealing

particulate - of or relating to minute separate particles

pathogen - a specific causative agent (as a bacterium or virus) of disease

permit - 1. a formal order giving permission to do something
2. a document issued by the provincial government specifying the conditions by which the disposal or discharge of wastes into the environment is allowed

photoplankton - microscopic plant life which requires sunlight to grow

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pollutant - something that pollutes, ie, makes impure or useless, especially man-made wastes

pollution - the contamination of soil, water or the atmosphere by the discharge of wastes or offensive material, such as gases or chemicals which impair the environment

predator - animals which prey on and eat other animals

primary treatment - the simplest level of treatment which removes floating and settled solids from sewage

producers - 1. the plant component of an ecosystem which creates matter through the use of sunlight, water and nutrients
2. one who produces goods and services; opposite to consumer

radionucleide - any form of an atom which is radioactive

recycle - returning to production an "item" that has exhausted its primary use. It involves the recovery of waste materials after purchase or production at the source of generation. Recycling is a form of resource recovery.

regulations - specific requirements which are enforced under the law

renewable - resources which (if managed properly) are produced continuously

residuals - materials or substances which remain after the extraction of all useful materials

resource - 1. any thing that meets a need
2. a material which can be used by animals or people for a useful purpose. Resources become through technological and organizational abilities. Resources are functional, not necessarily tangible.

resource conservation - the management, including either preservation or use, of our natural resources for the well-being of people, taking the total environment into account

resource recovery - a strategy to promote the reduction, reuse and recycling of wastes

responsibility - an obligation; the condition of being accountable to a duty or trust, without direct supervision or regulation

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sanitary landfill - an engineered method of disposing of wastes on land by spreading it in layers, compacting it and covering it, taking regard for environmental impact through leachate systems, groundwater protection and gas control

scrubbers - equipment for removing fly ash and other objectionable materials from the products of combustion by means of sprays, wet baffles, etc. Also reduces the temperatures of effluent gases

secondary treatment - the use of chemical or biological processes usually in addition to primary treatment, to remove most of the dissolved organics in sewage

secure landfill - a landfill site which is designed to prevent the contents from coming in contact with the surrounding environment

sewage - waste matter from people and industry that passes through sewers, especially before it is treated

sewerage - the system of pipes and conduits which transports sewage to a treatment or disposal site

sludge - 1. a thick, soft, muddy mixture
2. the semi-liquid residual waste which remains after the treatment of sewage

slurry - a semi-fluid mixture of liquids and solids

solid waste - all items in a solid state discarded after use

source reduction - a decrease in the volume of waste generated at the source (household, process or institutional level)

source separation - the segregation of various wastes at the point of generation for the purpose of recycling

spin-off-effects - long term, indirect impacts of investments and activities

subsidy - monetary aid or grant (eg, diversion credit given by a government)

succession - the process an ecosystem undergoes to evolve into a different form of environment

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7/...GLOSSARY OF WASTE MANAGEMENT TERMS

tailings - a surry waste resulting from ore processing consisting of water, suspended solids and chemicals

tangible - perceptible by touch; in economic terms it implies that a dollar value can be attributed

tertiary treatment - the highest level of sewage treatment which removes specific substances, such as phosphorus and nitrogen, from secondary-treated effluent

total loading - the total amount of wastes released into an environment over a specific period of time

trade-offs - compromises; things given up in order to prevent unacceptable negative impacts

transformers - device to change power in an electrical circuit

wants - desires which make life easier, more convenient or more pleasant

waste - goods no longer wanted or needed by society at this point in time

waste stream - the flow of wastes which results from human activities

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IV - SAMPLE ARTICLES FOR PROMOTION IN DISTRICTS

The attached articles have appeared in several educational journals. Feel free to adapt and use them for your promotional purposes.

RESOURCES AND WASTES

We all agree that process is important in the education of students who will soon be faced with difficult decisions as citizens and consumers. But they also need primary information -- both to help dispel old myths and to enable them to evaluate new data.

"Resources and Wastes" is a new environmental education program developed by the Ministry of Environment and Parks containing up-to-date information to help you introduce students to the complex problems and solutions associated with waste.

Included in the eight individual modules are support graphics, tables, charts, background information, projects, activities and a teacher's page. The teacher's page provides a synopsis of the module, learning outcomes and a content outline. The modules, which can stand alone, are contained in a three-ring binder. If you are limited to an introduction to the topic of waste management, the first module provides a general overview of the entire program.

The following topics are included in the program for a detailed analysis of the complex problems and solutions associated with waste management:

- the types, sources, and amounts of waste produced,
- waste management practices and their effects,
- the cost of waste to society and the individual,
- resource recovery and resource conservation options,
- consumer choices and their effects on the environment,
- roles, responsibilities and legislation,
- strategies for getting involved in the reduction of waste.

.../2

"Resources and Wastes" reflects many of the following goals for the Junior Secondary Science program, for example, under the section on Ecology and Resource Management, the student will be able to:

* Develop a sensitivity for the delicate balance of ecosystems and populations in the environment.

* Develop an appreciation for the impact of technology on the world.

* Develop a more responsible attitude towards self and society through the examination of an environmental issue.

* Understand how some of our activities alter the biotic and abiotic environment.

* Appreciate how their lifestyle affects their environment.

* Investigate or monitor pollution, interpret the information and apply it to acceptable standards.

* Describe a local resource emphasizing population considerations and environmental effects.

* Demonstrate a knowledge of various types of pollution.

* Predict the effects of various types of pollution on the environment.

* Identify the complex problems and solutions associated with waste disposal.

.../3

"Resources and Wastes" has been pilot tested by science, social studies, geography and consumer education teachers. Several notable strengths of the program are:

1. The examples are predominantly about British Columbia.
2. A wide variety of learning approaches are suggested providing the inquiry and hands-on approach.
3. The modular format provides flexibility.
4. References, free material and resources, including audiovisual materials are listed for each module.

One complimentary copy has been distributed to each district resource centre in B.C.

Additional copies are available for a cost of $10.00 from the Ministry of Environment and Parks. Please make your cheque payable to the Minister of Finance. The program is also available at a cost of $10.00 from the B.C.T.F., Lesson Aids office at 2235 Burrard Street, Vancouver, B.C., V6J 3H9.

School districts interested in providing introductory workshops should contact my office: Ministry of Environment and Parks, Information Services Branch, 810 Blanshard Street, Victoria, B.C., V8V 1X5, or call 387-9417.

CONSUMER CHOICES AND ENVIRONMENTAL EDUCATION

Marnie Miiller, B.Ed.
Education Co-ordinator, Ministry of Environment and Parks

Environmental considerations play a prominent role in community issues and in the marketplace. Since environmental decisions increasingly involve a high degree of public participation, students need to be aware of these concerns in order to function as responsible citizens and informed consumers.

Helping students develop this kind of awareness is an important goal of the B.C. Ministry of Environment and Parks' education program. To that end, the Ministry develops and makes available a variety of high quality educational materials aimed at a broad spectrum of students, teachers and the public.

One major issue which has been an important focus in the Ministry's public information and education program is the waste of energy and resources, and the accompanying damage to the environment, caused by poor waste disposal practices. Ultimately, much of this waste is the result of uninformed consumer decisions. Consequently, combining consumer education with environmental education can provide students with a broader perspective from which to analyze the issues -- as well as the knowledge and skills to take effective action in their daily lives.

.../2

In the future, environmental quality will depend increasingly on consumers who make a conscious effort to conserve energy and materials by reducing waste both in the marketplace and in the home. This, in turn, will require a better understanding of resource use, energy requirements and waste management options, and of their significance for both the individual consumer and the economy as a whole.

Promoting this kind of understanding demands an interdisciplinary approach which reflects the complex interactions between humans and the environment.

The Ministry took these requirements into account in developing its most recent environmental education program, Resources and Wastes -- a modular program which defines waste, explains where waste comes from, explores avenues for reducing waste, and promotes resource conservation. The activities, projects and information are designed to help students develop a basic understanding of the issues and solutions associated with waste management, especially in the areas of pollution, recycling and resource recovery.

Listed below are several reasons why the Ministry and the advisory committee, which consisted of a select group of teachers, felt this program would be an important part of the education of students.

.../3

* Consumer products which end up as waste can have a negative impact on the air, land and water.

* There are hidden costs which are assumed by all consumers for the production of consumer goods, and the disposal of goods no longer wanted or needed by society.

* Waste from consumer products represents dollar and energy costs and contributes to resource depletion.

* Potential energy, as well as resource and dollar saving's can be achieved through recycling and conservation practices by industry, government and the individual.

* Recent technological and managerial developments can reduce the problems and costs associated with waste disposal.

The Resources and Wastes package closely reflects the following course goals for Consumer Education 9, 10 and 12.

* To help students make and evaluate consumer decisions based on their values and goals while appreciating the affect of their choices on the environment.

.../4

* To analyze and assess the responsibility of the consumer to conserve and reduce or prevent pollution.

Resources and Wastes has been pilot tested by science, social studies, geography and consumer education teachers. The complete educational package contains the following components, along with supporting graphics and charts, in a three ring binder:

* eight fact-filled modules
* a comprehensive teacher's guide for each module
* references and resource information
* post-test
* projects and activities

The package has been distributed to district resource centres and is available for $10.00 from the British Columbia Teachers' Federation, 2235 Burrard Street, Vancouver, B.C., V6J 3H9, or the Information Services Branch, Ministry of Environment and Parks, 810 Blanshard Street, Victoria, B.C., V8V 1X5.

Inquiries should be directed to Marnie Miiller, Education Co-ordinator, Information Services Branch, telephone (604)387-9417.

RESOURCES AND WASTES

Lesson Plan Outline

SUBJECT: ____________________ GRADE: __________

MODULE:

CONCEPT: ____________________

PURPOSE: ____________________

OBJECTIVES: ____________________

PREPARATION: ____________________

RESOURCE PEOPLE: ____________________

SUPPORT MATERIAL/AUDIO VISUALS: ____________________

DURATION OF LESSON: ____________________

COURSE GOALS COMPLEMENTED BY THIS LESSON: ____________________

KEY CONTENT IDEAS

LEARNING ACTIVITIES

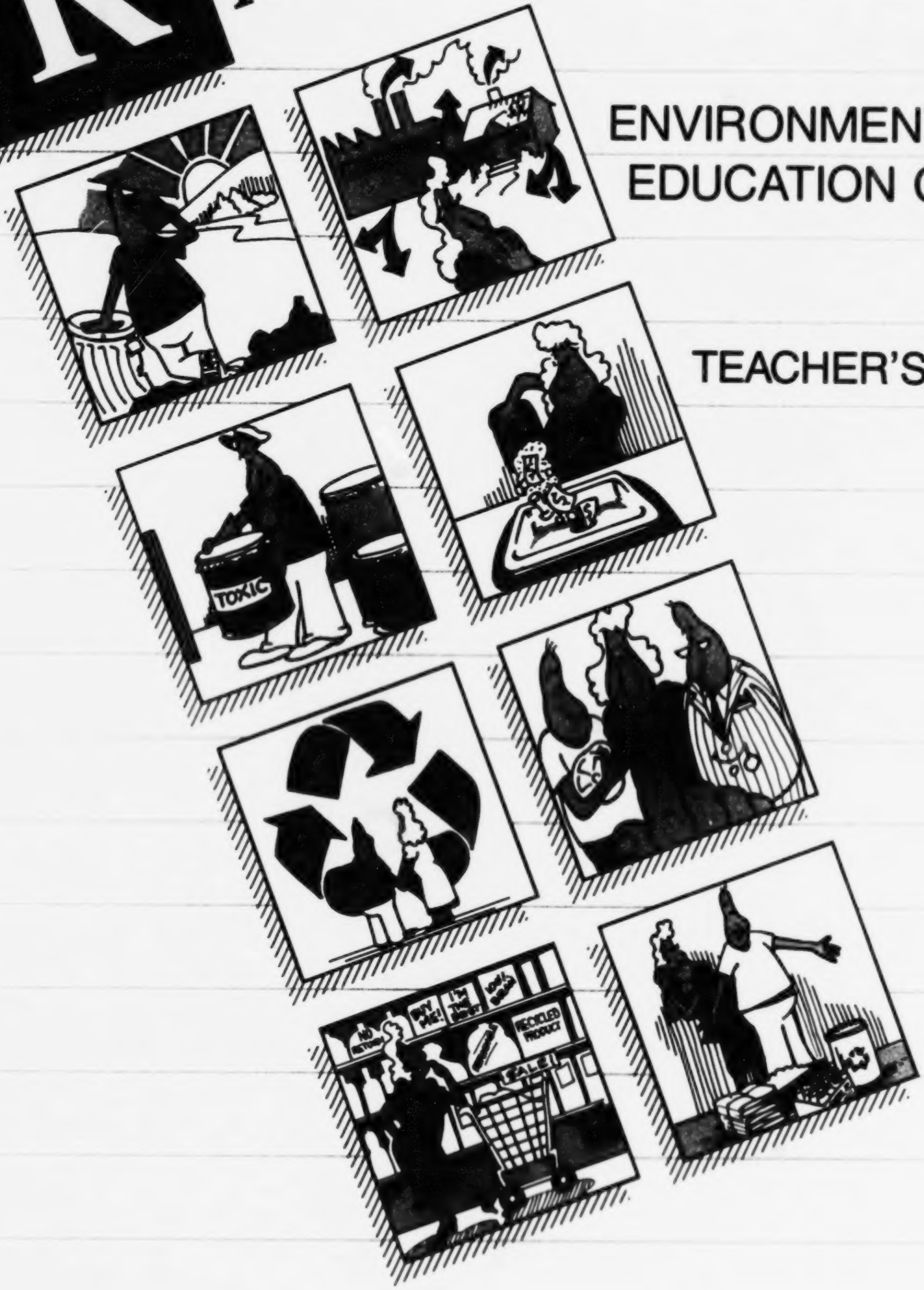
APPENDIX I

SECTIONS OF LESSON:	FOLLOW-UP ACTIVITIES/EVALUATION
	QUESTIONS FOR CREATIVE THOUGHT:

RESOURCES AND WASTES

ENVIRONMENTAL EDUCATION GUIDE

TEACHER'S GUIDE



BC
MINISTRY OF
ENVIRONMENT

TEACHER'S GUIDE TO "RESOURCES AND WASTES"

TO REDUCE WASTE AND PROMOTE RESOURCE CONSERVATION AND RESOURCE RECOVERY.

British Columbians produce an abundance and variety of wastes. The costs and difficulty of dealing with these wastes has increased dramatically in recent years.

Each person in B.C. produces about 1.5 kilograms of waste material every day. About one kilogram of that amount is produced at home while the remainder is generated at work or school. In other words, each British Columbian produces about 550 kilograms of garbage a year: a household of four creates two tonnes of wastes. The cost of disposing of domestic wastes in British Columbia is about $100 million a year.

There are other wastes besides those generated at home. Cars, trucks and aeroplanes create air pollution. Industries which produce a wide range of goods and services also contribute to air pollution. In some cases the wastes produced are toxic and require special treatment.

Not all wastes, however, are "wastes". It's estimated that up to half of the materials generally known as "wastes" are actually "resources", substances which could be recovered, recycled or reused. Recovering these resources would help reduce our need for new resources and decrease the adverse affects on the environment of waste production and disposal.

Although the environment has a remarkable capacity to deal with many of our wastes, the toxidity and amount of some wastes is too much for the environment to handle. It is important that all of us find ways to reduce our wastes and improve our methods of treating and disposing of them.

PURPOSE

The *Resources and Wastes* package developed by the B.C. Ministry of Environment is intended for use as a supplementary teaching aid in subjects such as science, social studies, consumer and environmental education at the Grade 8–12 level in B.C. schools.

The purpose of the *Resources and Wastes* package is to help secondary students to develop a better understanding of:

(1) the types, sources and amounts of wastes currently produced;
(2) waste management practices and their effects;
(3) the costs of wastes;
(4) resource recovery as a way of improving waste management;
(5) the responsibilities of individuals, business, industry and government in waste management;
(6) the effects which consumers have on resource use and waste production;
(7) ways in which individuals can help improve waste management in their homes, schools and communities.

It is hoped that exposure to these materials will encourage students to seriously consider ways they might improve waste management in their daily lives.

ORGANIZATION OF THE MATERIAL

The *Resources and Wastes* package is made up of a series of eight modules. Each module consists of a teacher's page as well as information, references and a number of suggested questions, projects and activities. The topics in the modules are:

1. "Resources and Wastes"

An introductory overview to waste management and production.

2. "Waste Streams"

The solid, liquid, gaseous and special wastes produced in domestic and industrial streams.

3. "Waste Management"

The ways in which solid, liquid, gaseous and special wastes are managed in B.C. as well as some ways in which waste management practices may be improved.

4. "Wastes Costs"

Examines a number of tangible and intangible as well as direct and indirect costs of wastes.

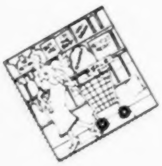
5. "Resource Recovery"

Deals with resource recovery as a practical way to improve our waste management practices.

6. "Roles, Responsibilities and Legislation"

Examines the responsibilities of individuals, businesses, industries and government in waste management and identifies specific pieces of legislation governing the production and management of wastes.

7. "Consumer Choices"



Discusses some of the factors which affect consumer choices and examines some of the effects which such choices can have on the use of resources and management of wastes.

8. "Getting Involved"

Outlines a number of specific ways in which individuals can reduce wastes and improve waste management in their homes, schools and communities.

GRAND TOTAL (from the other side)

IF YOUR SCORE WAS:

40 or more

Like most Canadians you are probably contributing your full share of waste to our rapidly filling landfills, including tons of usable, recoverable materials which are buried in B.C. each day!

what you can do!!

- Be aware of the amount of garbage you have each day. Note how heavy it is. What could be reused, recycled, or avoided?
- Next time you go to the store check to see if any of the products you normally buy in non-recyclable containers are also available in returnable, refillable, or recyclable containers.
- Call your nearest recycling depot or the GVRD/SPEC Hotline, 736-8636 for information on how, where and when to recycle.

between 21 and 39

You are doing some reducing, reusing and/or recycling. These patterns need to be practiced consistently by the majority of the population if we are going to reduce the increasing amounts of waste.

what you can do!!

- Do some comparison shopping. Consider various types of packaging and the alternatives which are available. Does it cost more or less to buy reusable or recyclable packages?
- Take your own grocery and plastic sacks back to the store and reuse them.
- Call the nearest Recycling Depot about some items in your house you would like to recycle. GVRD/SPEC Hotline, 736-8636. Recycling Council of B.C. — 731-7222.

20 or less

You've obviously done some serious thinking about the need for resource recovery and conservation. It shows!

what you can do!!

- Think about the things you do to conserve. Which are you the most proud of? Encourage one other person to consider conservation.
- Get involved in solid waste planning in your community.
- Keep up the good work!

LESS IS BETTER

when it comes to garbage and energy consumption

HOW DO YOU STACK UP?

Every day we do (or avoid doing) things which affect the amount of waste we produce. Here's an opportunity for you to stop and consider just what your contribution is — to the problem and to the solution. Take a few minutes to complete this checklist. Add up the circled numbers in the three columns and find your total. Then use the information on the back to see how you stack up.

DO YOU . . . . . .

	NEVER	SOME-TIMES	OFTEN
1. consider whether you really need something before you purchase it?	3	2	1
2. think about what will happen to a product or package when you no longer have any use for it?	3	2	1
3. try to reuse things you already have instead of disposing of them and buying new things?	3	2	1
4. consider what pollution and wastes were created in the manufacture of the things you buy?	3	2	1
5. take advantage of the opportunities to recycle in your area?	3	2	1
6. shop at second-hand stores or garage sales?	3	2	1
7. use dishclothes or sponges instead of disposable paper products which can't even be recycled?	3	2	1
8. avoid items such as disposable diapers, razors or lighters when longer-lasting alternatives are available?	3	2	1
9. avoid eating in carry-out places which wrap your food in lots of paper and plastic or ask that less wrapping be used for **your** order?	3	2	1
10. compost kitchen waste and other decomposable organic matter?	3	2	1
11. spend the money to repair an item even though you could get a new one for nearly the same price?	3	2	1
12. talk to store managers about stocking bulk products or avoiding packaging?	3	2	1
13. complain to manufacturers about "built-in obsolescence"?	3	2	1
14. write to government officials and leaders expressing your concerns about the need to produce less wasteful products?	3	2	1
15. read consumer information articles to find out about the quality and durability of products you buy?	3	2	1
	______	______	______

☐ + ☐ + ☐ =

BC MINISTRY OF ENVIRONMENT

grand total ____________

Oregon Department of Environmental Quality,
Solid Wastes Division. Reprinted with permission

SUGGESTIONS FOR USE

The *Resources and Wastes* package was designed so that teachers and students can use it however they wish.

Teachers and students could work their way through the entire package or select only those parts suited to their needs. Those wishing to do a condensed unit should consider using #1 "Resources and Wastes" as an introductory overview, and #8 "Getting Involved" as the basis for a home, school or community recycling or waste reduction project.

At the end of each module is a series of suggested questions, projects and activities which will guide students through learning experiences ranging from knowledge, comprehension and application to analysis, synthesis and evaluation. Teachers and students are encouraged to select whichever questions, projects and activities best suit their needs and purposes.

At the end of this teacher's guide is a one-page questionnaire which can be used to survey attitudes and habits relating to waste production and management. Teachers may wish to use this as a "pre-test/post-test" in order to ascertain if students undergo any changes in their attitudes or habits as a result of using materials from the *"Resources and Wastes"* package.

ADDITIONAL REFERENCES AND RESOURCES

At the end of each module is a list of references and resources relating to the topic.

The following is a list of additional references, resources and audio-visual materials which teachers may wish to obtain and use.

EDUCATIONAL PACKAGES

A-Way with Waste: A Waste Management Curriculum for Schools, Washington Department of Ecology, 4350 — 150th Ave., Seattle, Washington, 1984

This guide is organized around concepts of solid waste management: (1) changing attitudes; (2) what is waste; (3) reuse, recycle and recover resources. Seventy-five lesson plans on topics ranging from everyday activities to such global issues as resource depletion are incorporated in this 300 page book. The lesson plans cover various subject areas appropriate for grades K–12.

Environmental Education Kit — Recycling and Conservation, Environment Canada, Ottawa, Ontario, 1984

This free package includes background information and activities in recycling and conservation. Activities can be modified for grades 4–12.

Guidelines for Recovering Residential Waste Materials Through Source Separation, Waste Management Advisory Board, 1 St. Clair Avenue West, 6th Floor, Toronto, Ontario, M4V 1K5

This publication provides guidelines for setting up a community recycling program in Ontario. However, much of the information is applicable to British Columbia. (1980)

Hazardous Waste Education Kit, The Federation of Ontario Naturalists, FOW Conservation Centre, Moatfield Park, 355 Lesmill Rd., Don Mills, Ontario, M3B 2W8

The kit is for science, environmental science and geography teachers of grades 7–12. It contains ready-to-use lesson plans, follow-up activities and student worksheets, as well as study materials, several handbooks, factsheets, posters and other up-to-date resources. Kit cost — $45.00 plus $5.00 postage and handling.

Secondary Energy Education Materials, B.C. Hydro and Power Authority, 970 Burrard Street, Vancouver, B.C. V6Z 1Y3

The 40 units are intended to be used as supplements to existing curriculum. The materials focus on a variety of topics relating to energy and conservation. The units are grouped according to topic, such as energy and food, energy and transportation and energy and the home. The materials are available free of charge.

PERIODICALS

BioCycle: Journal of Waste Reduction, Box 351, Emmaus, Pennsylvania 18940

Features articles on long-term, lower cost waste treatment methods.

Environment Update, Environment Canada, Ottawa, Ontario K1A 0H3

This quarterly publication contains various articles on different factors which affect the environment. The aim of *Environment Update* is to inform interested people about the programs and activities of Environment Canada.

Recoup, 223-A McLeod Street, Ottawa, Ontario, K2P 0Z8

Articles and advertisements prepared expressly for the recycling materials industry in Canada. Articles cover various subjects relating to the industry, such as market information, expert opinions and technical information.

Resources: Resources for the Future, RFF Publication and Information Division, Room 500, 1755 Massachusetts Avenue, N.W., Washington, D.C. 20036

This publication contains articles dealing with research regarding the development, conservation, and use of natural resources and the quality of the environment.

Resource Recycling: Journal of Recycling, Reuse and Waste Reduction, (published six times a year), 1615 N.W. 23rd, Suite One, P.O. Box 10540, Portland, Oregon 97910 California

Features a variety of articles on recycling, reuse and waste reduction. Focuses mainly on the U.S. and Canada.

Water & Pollution Control, Southam Business Publications, 1450 Don Mills Rd., Don Mills, Ontario, M3B 2X7

This is a bi-monthly business publication providing specialized coverage of the water, wastes and industrial pollution fields. Comprehensive information is provided on municipal and industrial water and wastes treatment and supply with particular reference to all aspects of pollution control.

MINISTRY OF ENVIRONMENT PUBLICATIONS

The following materials are available free of charge from the B.C. Ministry of Environment. To obtain any of the materials write:

B.C. Ministry of Environment
Information Services Branch
810 Blanshard Street
Victoria, B.C.
V8V 1X5

A Waste Management Promotion Campaign **(1984)**

This leaflet contains a potpourri of 17 waste management activities for primary to secondary students which may use the entire community as a learning laboratory. Includes a list of audio visuals.

Acid Rain in the West **(1984)**

This general information fact sheet explains what acid rain is and discusses the problems it poses as well as the steps being taken in Canada to solve the problem.

Garbage Is Resourceful **(1984)**

This 21 page booklet briefly covers the causes, costs and choices regarding waste management. Includes facts on composting. Identifies some of the recycling depots in B.C.

Safe Pesticide Use: Around the House and Garden **(1984)**

This 12 page brochure indentifies safe storage, applications and disposal of pesticides for the home and garden.

Special Wastes **(1984)**

This fact sheet discusses what special wastes are, where they come from, who pays and what program exists within the Ministry of Environment to control special wastes.

Special Wastes in B.C.: An Environmental Education Package **(1983)**

The package is designed to assist science, geography, social studies and consumer education students to explore the topic of hazardous waste and help develop an understanding of the B.C. options for handling these wastes. The package contains background information fact sheets, lesson plans and overhead masters.

AUDIO-VISUAL MATERIALS

(MODULES #1, #2)
Air

2 minutes colour NFB #106C 0372 079

Although only 2 minutes long, this film emphasizes the importance of oxygen and the threat posed by man-made pollutants. It is a wordless, animated film in which plants, birds, fish and finally man come to the same "breathless" end. 1972

(MODULES #1, #2)
Acid Rain: Requiem or Recovery

27 minutes colour NFB #106C 0181 527

Graphs, maps and scientific experiments serve to examine what acid rain is, where it originates and how it threatens the environment. 1981

(MODULES #6, #8)
Citizen Harold

9 minutes colour NFB #106C 0171 096

An animated film about one man's attempt to bring about changes in his community through participation with fellow citizens and local government. A discussion-starter with a dual ending for groups exploring methods of bringing about change. 1971

(MODULE #8)
Class Project: The Garbage Movie

23 minutes colour NFB #106C 0180 068

A group of pupils, aged 8–13, start off on a school project to find out all they can about garbage, its composition, its disposal and the impact of its disposal on the environment. The places they visit tell us a lot about the society we live in, and about ecology, cities, art and history. Most important of all, students learn that what we do today has an impact on what happens tomorrow. Support material available. 1980

(MODULE #1)
Face of the Earth

17 minutes colour NFB #3106C 0175 109

This film explores the origins of our planet's outer layer. Through the use of well-designed diagrams the earth's cyclical activity is clearly explained. 1975

(All Modules)
Garbage is Resource Full

24 minutes colour video PEMC #VCE 52

This video was prepared by the B.C. Ministry of Environment and provides an overview of the generation of wastes and the options that are available to reduce, reuse and recycle household wastes. 1983

(MODULE #2)
Man: The Polluter

53 minutes colour NFB #106C 0173 107

A cartoon film co-produced by the NFB and Zabreg Films (Yugoslavia) which richly illustrates people's ability to pollute the environment. In between animated sequences professor Fred Knelman of Concordia University in Montreal comments on the importance of what is known. Long and somewhat dated but enlightening. 1973

(MODULE #4)
That's The Price

41 minutes colour NFB #106C 0170 106

Two points of view concerning what the infusion of industrial capital meant to two dying coal towns in B.C. The film shows what happened when an American firm came to the twin towns of Natal and Michel with a contract for millions of tonnes of coking coal for the steel mills of Japan. From what is seen and said in this film, industrial growth has its price, especially in regard to the environment in the region. 1970

(MODULE #7)
The Bronswik Affair

23 minutes colour NFB #106C 1078 017

A very funny, yet deadly serious film, which demonstrates the effectiveness of advertising in motivating people to buy products they don't need. It entertains through the comic appeal of its characters and the baroque situations they fall prey to. It also lays bare some facts about the excesses of consumerism prompted by a steady flow of commercials.
(10 international awards) 1978

(MODULE #2)
The Garbage Explosion

16 minutes colour
Available from PEMC #50-655

This film investigates the nature, volume and composition of solid wastes. 1970

(MODULE #1)
The Other World

19 minutes colour NFB #106C 0176 001

An exploration of the world of plant and animal life in a Canadian stream. Using underwater photography and microphotography, the camera follows some underwater life cycles and shows the interdependence of insects, fish and mammals which are in turn dependent upon clean water. 1976

(MODULE #7)
This Is a Recorded Message

10 minutes NFB #106C 0373 028

Made up of hundreds of cut-out colour ads projected in fragmented, rapid succession, this animated film without words takes a critical look at the conditioning process that underlies consumerism in our materialistic world. Seductive advertising is seen as the main motivating force in shaping the desires, needs, and to a large degree, the lives of modern men and women. A provocative film to stimulate reflection. 1973

(MODULES #1, #2, #3)
Water

15 minutes colour NFB #106C 0161 070

A film showing why the preservation of ample clean water requires the joint effort of all nations. Water and all creatures that depend on it, are in danger. Pollution of rivers, loss of soil fertility and erosion are some of the urgent problems depicted. A United Nations Film. 1961

(MODULE #4)
What on Earth Are We Doing

12 minutes NFB #106C 0175 608

Canadians are using up their resources at a rapid rate, fifty times faster than the people of India, for example. If we calculated our population according to our rate of consumption, we would have a country of 1.1 billion people. Fortunately, more and more of us are becoming aware of the urgent need to build a way of life based not just on "more" but on "better". 1975

MODULE #1

RESOURCES AND WASTES

BC MINISTRY OF ENVIRONMENT

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(module 1)

1. Refuse and refuse disposal - British Columbia.
I. British Columbia. Ministry of Environment.

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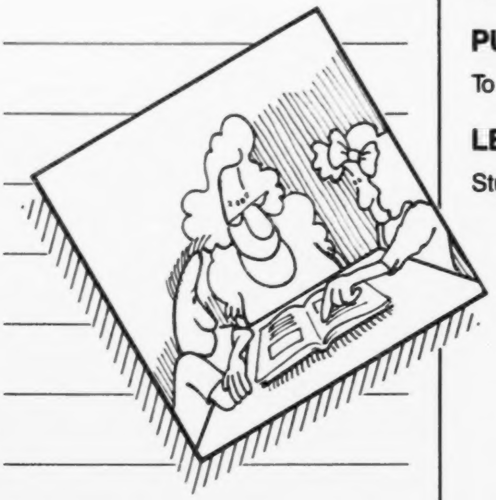
TEACHER'S PAGE



MODULE #1

RESOURCES AND WASTES

SYNOPSIS

This module provides an introductory overview to the "Resources and Wastes" package. The first part reviews some of the basic concepts relating to the way in which ecosystems function. This is followed by an examination of the generation and treatment of waste. The module also explores the costs involved in waste management, options for resource recovery and the roles which individuals, businesses and government have to play in waste management. The final sections discuss the effects which consumer's decisions have on resource use and waste production and the ways people can get involved in improved waste management.

PURPOSE

To gain an overview of waste production and management.

LEARNING OUTCOMES

Students will be able to:

- (a) recognize that the earth is a closed system in which natural waste materials are constantly recycled through the ecosystems
- (b) recognize that the ecosystems' capacity to absorb wastes is limited
- (c) identify the types of wastes generated and the methods used to treat them
- (d) recognize that the types and amounts of waste byproducts generated by humans can exceed the ecosystems' carrying capacity
- (e) identify and evaluate some of the environmental, social and economic consequences when the concentration of wastes exceeds the ecosystems' carrying capacity
- (f) identify and compare the tangible and intangible costs associated with waste management
- (g) identify and distinguish between the roles individuals, businesses and government have in waste management
- (h) explain the ways in which consumer decisions affect resource use and waste production
- (i) demonstrate ways to reduce, reuse or recycle wastes in the home, school or community.

Content Outline

1. The earth as a system
    - (a) ecosystems
        - — producers, consumers and decomposers
        - — food chains and food webs
        - — carrying capacity
        - — ability of the ecosystems to absorb waste
    - (b) natural cycles
2. Waste Streams
    - — domestic and industrial waste stream
3. Problems Associated With Wastes
    - — the negative effects of various types and amounts of wastes on the environment (e.g. air, land, water)
4. Waste Management Practices
    - (a) solid
    - (b) liquid
    - (c) gaseous
    - (d) special

44B

5. Cost of Waste Management
    - (a) tangible and intangible costs
    - (b) direct and indirect costs
6. Resource Recovery
    - (a) reduce, reuse and recycle
    - (b) cost of resource recovery
    - (c) benefits of resource recovery
    - (d) barriers and incentives
7. Roles, Responsibility and Legislation
    - (a) individuals
    - (b) industries
    - (c) government
        - — federal
        - — provincial
        - — municipal
8. The Effects of Consumer's Choices on the Use of Resources and the Production of Wastes.
9. Getting Involved With Waste Management

Suggested Use	Time Required
Science 8–10 Social Studies 10 Consumer Education Environmental Education Science and Technology 11	1–2 hours

Module #1 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports, and publications dealing with various aspects of resource recovery and use such as "The Fascinating World of Trash", *National Geographic*, April, 1983.
2. The other teaching aids in the Resources and Wastes package including; #2 "Wastes Streams", #3 "Waste Management", #4 "Wastes Costs", #5 "Resource Recovery", #6 "Roles, Responsibilities and Legislation", #7 "Consumer Choices" and #8 "Getting Involved".

MODULE #1 — REFERENCES AND RESOURCES

Downwind: An Acid Rain Story, Environment Canada, Ottawa, Ontario, 1977

Ecology And Field Biology, Smith, Robert L., Harper and Row Publishing, New York, N.Y., 1966

Learning About Environment, Harrington, R. and Passmore, R., Canadian Wildlife Federation, Ottawa, Ontario, 1972

Ontario Recycling Update, (published 6 times a year), Recycling Council of Ontario, Toronto, Ontario

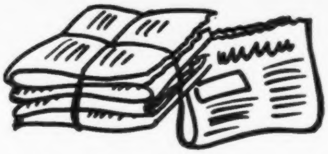
Repairs, Reuse, Recycling — First Steps Toward A Sustainable Society, The Worldwatch Institute, Washington, D.C., 1978

"*The Fascinating World Of Trash*", White, Peter T., National Geographic, Washington, D.C., April, 1983

UPDATES

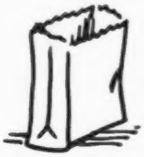
HOW AND WHAT TO RECYCLE

SOURCE SEPARATION — means setting aside recyclable materials like paper, cardboard, glass and metals from wastes in your household or business. Successful recycling depends on materials not being mixed with garbage or other types of recyclables.
FOR MORE INFORMATION CALL Ministry of Environment 387-4321.



Newspapers

Pile in 12" bundles. Secure with twine. No magazines or phone books.

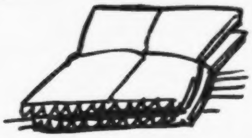


Brown Grocery Bags

No bags of other colors. Printing on bag OK. Bag or box.

Magazines

Bundle or box.



Corrugated Cardboard boxes

Flatten, bundle, tie with twine. No cereal or shoe boxes, waxed or plastic-coated cardboard. Egg cartons OK.

Office Waste Paper

Includes white or colored ledger, computer paper and cards. Box or bag.

Glass

Rinse, remove lids, caps or neck rings. Paper labels OK. Color sort — green, brown, flint. Bag or box. No window glass, pyrex or drinking glass.

Bottles

Most pop and beer bottles returned for refunds. Depots which take them are listed in the Yellow Pages under *Bottles — Used*, or return to retail place of purchase.

Plastics

Recycling plastic waste is difficult especially on a small scale. Since no market exists it is best not to accumulate more plastic than you can *reuse* yourself. Plastic pop bottles can be returned for refund.

Tin Cans

Rinse, remove labels. Remove ends and put in with cans, flatten. Box or bag cans. No lids or bottle caps.

Aluminum

Clean and flatten, all foil, food and non-refundable beverage containers. No foil with paper adhering. Also recycle pots, pans, lawnchair frames, and kitchen utensils.

Other Metals

Household scrap which can be sold for recycling include household appliances, pipe, sheet metal, machinery parts, lead batteries and copper. A list of scrap metal dealers will be found in the Yellow Pages under *Scrap Metal*.

Used Motor Oil

Place in unbreakable, closed containers. Return to an **Oil Save** Depot.

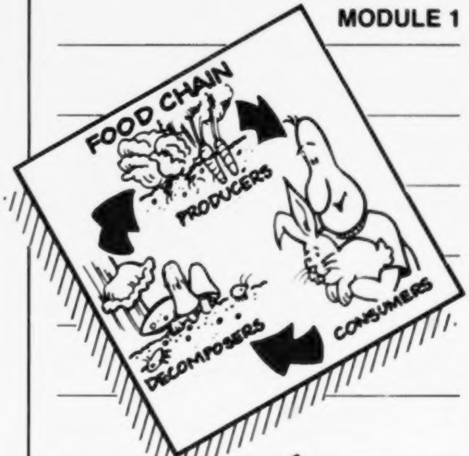
Food and Garden Waste

Food and garden wastes make up one-third of household waste. Composting is a means of processing these wastes into an enriching soil conditioner for your garden while diverting a significant amount of material from your community's solid waste stream. Information on how to compost is available from Waste Management Branch, Ministry of Environment or Horticulture Branch, Ministry of Agriculture.

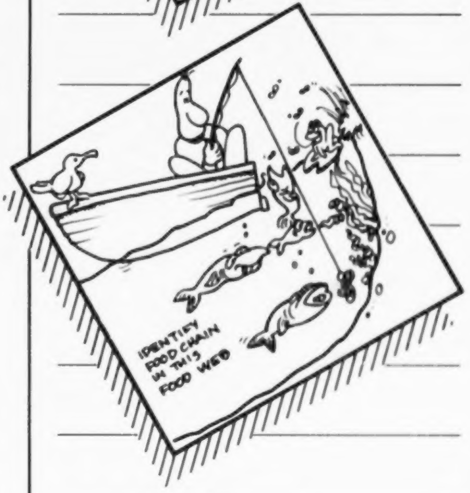
RESOURCES AND WASTES

Our planet has been called Spaceship Earth. Like a self-contained spaceship, it provides all the *resources* needed to support life: air, water, food, and materials for heat and shelter. It also comes equipped with ways to break down and recycle *wastes.*

Spaceship Earth operates on the basis of a series of cycles and processes. Through the process of *photosynthesis*, for example, green plants use energy from the sun to produce sugars from carbon dioxide and water. These plants are called *producers.* Animals which eat green plants and other animals are known as *consumers.* Another group of organisms, comprised of both plants and animals, is called *decomposers.* Decomposers break down dead plant and animal remains into simple substances which are absorbed by the roots of plants and used as nutrients for growth.



Producers, consumers and decomposers are linked to each other through their food relationships. These relationships are called *food chains* because they are like links in a chain. For example, in a pond, sunlight provides the energy which microscopic water plants need to grow. In turn these tiny plants support a variety of minute animal life. The small animals provide food for young fish, tadpoles and aquatic insects, which are eaten by larger fish, frogs and birds. In turn, the fish, frogs and birds are nourishment for herons, muskrats and other predators. Each link in the chain relies on the previous link for sustenance. If one link is broken, the entire chain may be weakened. For example, if the insect population of the pond were removed, there would be no food for the frogs, tadpoles and small fish. In turn, this would affect creatures farther up the food chain such as herons.


IDENTIFY FOOD CHAIN IN THIS FOOD WEB

Because most animals have varied feeding habits, food chains often overlap. In the pond example, herons eat different species of fish, tadpoles and frogs, and are eaten by other predators. When food chains inter-relate, they are called *food webs.* Natural communities consisting of one or more fairly stable food webs are called *ecosystems.* A pond is an ecosystem. So is a coastal rain forest, an arid plateau or a mountain-top glacier.

An ecosystem supports a limited amount of life. The extent to which an ecosystem can supply food, water, air and shelter for its inhabitants, and can assimilate their wastes, is called the *carrying capacity.* If an ecosystem becomes overpopulated, it can no longer provide enough resources for all its inhabitants. Furthermore, an overpopulated ecosystem is unable to assimilate all the wastes produced by the population. When the carrying capacity is exceeded, something has to give: part of the population dies out or the environment becomes damaged, or both. In time, ecosystems adjust to changes in the internal balance. However, in the short term, the disruptions may be serious.

The ability of an ecosystem to absorb wastes is influenced by four factors: *type*, *quantity*, *concentration* and *time.* For example: a pond may be able to assimilate 1 000 kg (quantity) of dead plant matter (type) in small amounts (concentration) each day over the summer (time). But if there was a massive die-off of plant matter in one day, the pond would not be able to process all the wastes rapidly enough resulting in damage to the environment.

People are part of ecosystems. The same principles that govern the carrying capacity in a pond ecosystem apply to human communities. Like other members of an ecosystem, we depend on our environment to provide our food and assimilate our wastes.

In nature, resources and wastes are cycled through the environment in never-ending patterns. For example, the *water cycle* ensures that the supply of water on earth is constant and is used over and over again.

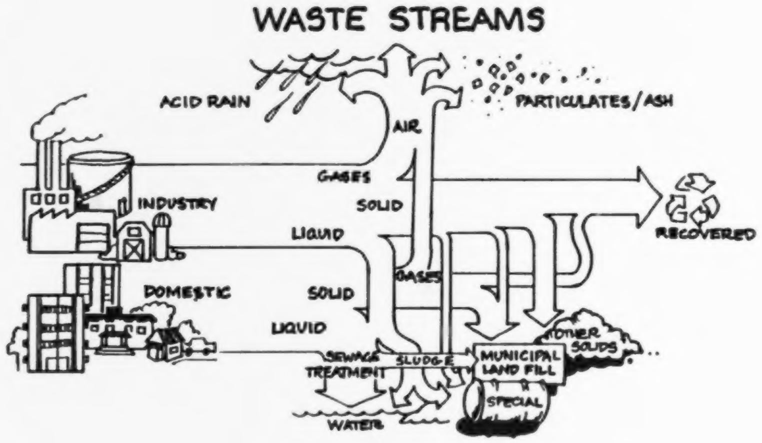
Another example of a natural cycle involves the regeneration of soil through the *decomposition* of plant and animal wastes. Decomposers (fungi and bacteria that live in the soil) break down the organic matter into simpler chemicals which dissolve in water. Then micro-organisms called *transformers* change the chemicals into substances that are absorbed by the roots of green plants.

There is virtually no waste in nature. What is *waste* to an animal becomes a *resource* to a plant, and vice versa.

However, the ways in which humans use resources and produce wastes are different from those in natural systems. We use resources more intensively than do other forms of life. We use technology to extract resources, synthesize chemicals, manufacture goods and carry on many other activities, all of which use energy and produce wastes. Rather than using a *cyclic* approach, we tend to use a *linear* approach in dealing with resources and wastes: use, discard, remove and forget. Our production of wastes also differs from nature in quantity, type and quality. Because people generally live in communities which produce wastes in quantities and concentrations too large for the immediate environment to absorb on an ongoing basis, these wastes must be managed in order to reduce environmental damage and prevent health hazards.

WASTE STREAMS

Wastes can be divided into two broad categories by source. The *domestic waste stream* includes all of the wastes generated by individuals at home, school and work. The *industrial waste stream* encompasses wastes produced by the industrial sector which, in British Columbia, consists chiefly of the forestry, pulp and paper, mining and smelting, manufacturing, and agriculture and food processing industries.



Canada is the world's second highest per capita producer of garbage. Each day, every Canadian generates about 1.5 to 2 kg of garbage at home, workplace and school. As a nation, Canada annually disposes of 450,000 cars, 22 million tires, 3 billion bottles and jars, and 5 billion cans.

Country	kg of garbage residence week
U.S.A.	24
Canada	22
Czechoslovakia	21
France	17
U.K.	16
Israel	14
Spain	13
Poland	12

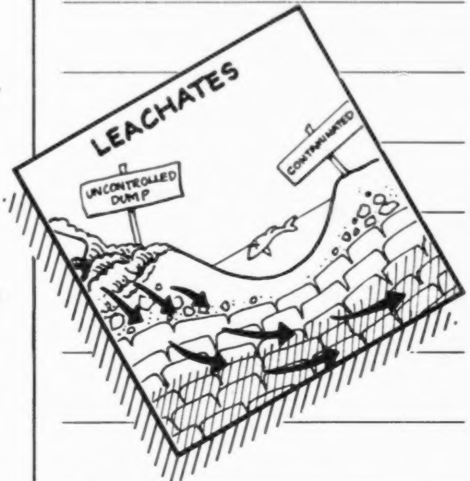
British Columbian households produce about 2 000 000 tonnes of waste each year.

Within the domestic and industrial categories, there are four types of wastes: *solid*, *liquid*, *gaseous* and *special*. Solid wastes include such things as paper, metal and glass. Liquid wastes are mainly composed of *sewage* and fluids from industrial processes. The vast majority of gaseous wastes are produced by automobiles and emissions from industries powered by fossil fuels. Special wastes refer to those wastes which, because of their nature, require special handling in transportation, storage and disposal, to avoid endangering people's health or damaging the environment. The list of special wastes ranges from used paint thinner in the household to industrial and institutional wastes.

Most domestic solid wastes end up in landfills and incinerators while domestic liquid wastes are discharged into bodies of water after going through sewage treatment plants. On the other hand, many industrial wastes are treated or disposed of on-site. In B.C., the disposal of any waste into the environment, whether in solid, liquid or gaseous form, requires a permit from the provincial government.

PROBLEMS ASSOCIATED WITH WASTES

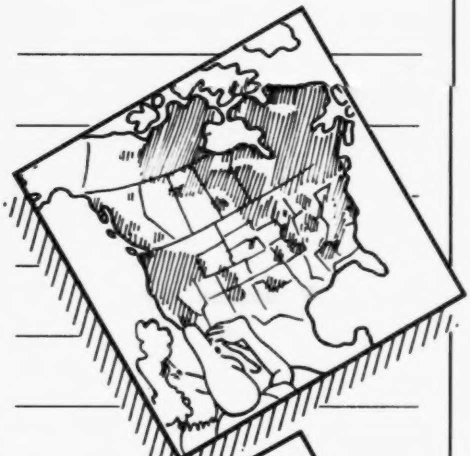
Problems associated with wastes are numerous and complex. Some components of wastes in landfills can *leach*, or drain, into the underlying soil. These *leachates* can contaminate groundwater and cause health problems. In the same way, industrial *effluents*, possibly containing heavy metals or other toxic substances, can end up in lakes and rivers. Because certain chemicals tend to accumulate in animal body tissues, they may become more concentrated the higher an organism is in the food chain, and may cause health problems for humans.

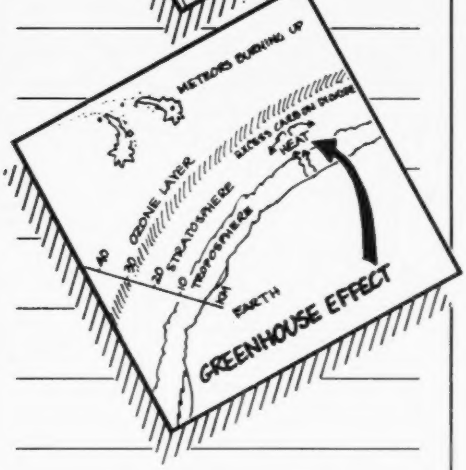


Without sophisticated tertiary treatment, sewage effluents may contain phosphates and nitrates which are nutrients for plants. When the effluents enter fresh water, they stimulate the growth of algae. When dead algae decompose, it causes a reduction in the level of oxygen in the water which can lead to the suffocation of other forms of life. This process is called *eutrophication* and is the first step in the succession of a pond or lake into a swamp, marsh or bog.

Gaseous wastes also cause problems. From 42 000 kilometres out in space, the Apollo X astronauts were able to identify Los Angeles by the *photochemical smog* over the city. This phenomenon occurs when sunlight causes a chemical reaction to take place between hydrocarbons and nitrogen oxides (waste products of motor vehicle engines and various industrial processes), producing ozone and other pollutants. Photochemical smog hampers people's breathing, damages plants, causes rubber to crack and fabrics to fade.

When gaseous emissions of sulphur dioxide and nitrogen oxides combine with water in the atmosphere, *acid rain* (rain that has a pH less than 5.0) is formed. It causes chemical changes in soil and water which, over time, can reduce soil fertility, retard plant growth and kill fish and aquatic life. Although the problem of acid rain is worse in eastern North America than in the west, recent studies indicate that rain falling on southwestern B.C. is more acidic than normal.





Another gaseous waste which results from the burning of fossil fuels is carbon dioxide (CO_2). When large amounts of CO_2 accumulate in the upper atmosphere, they form a barrier which, like glass in a greenhouse, traps heat. The result, known as the *greenhouse effect*, could cause the temperature on earth to rise. If this happened, then the arid regions of the world would likely expand and the polar ice caps would melt, raising water levels in the oceans and flooding coastal regions.

TABLE 1 — *SOME TYPES OF WASTES*

Type	Source	Components	Possible related effects
Gaseous Wastes	cars and combustion	—lead —carbon monoxide and carbon dioxide —unburned hydrocarbons —nitrogen oxides —particulates, ash	—health hazards —greenhouse effect —photochemical smog —acid rain (effects vegetation and aquatic life)
	manufacturing processes	—sulfur oxides —fluorides —hydrogen sulfide —particulates —smoke, soot, vapours, odours	—acid rain —fluorosis —health hazards
Solid Wastes	households commerce and institutional	—paper —organics (food & garden) —cans —glass —plastics —rubber, clothing	—high disposal costs —leachates from landfills —nuisance odors, vermin, etc.
	manufacturing industry	—wood wastes —mine tailings —chemicals —plastics	—leachates from landfills —health hazards
Liquid Wastes	domestic sewage	—disease carrying bacteria, coliforms —organic matter; cellulose —sugars, proteins, fats and oils —nutrients; phosphate, nitrates	—health hazards —eutrophication —aesthetic nuisance and odors
	industrial	—pulp mill liquor —oil —waste heat (thermal wastes) —chemicals	—danger to wild and aquatic life —effects ecosystem —health hazards
Liquid Wastes	agriculture	—pesticides —herbicides —organic phosphates —chlorinated hydrocarbons —lead —organic plant and animal wastes	—accumulate in body tissues and lead to health hazards —eutrophication of lakes
	landfill	—uncontained leachates available to go to groundwater and surface waters	—health hazards

Table 1 — *Some Types of Wastes—Continued*

Type	Source	Components	Possible related effects
Special Wastes	automotive	—oils —solvents	—danger to wild and aquatic life
	domestic	—cleaners —oils —stains —paints & thinners —turpentine —solvents —waxes —pesticides	—danger to wild and acquatic life —health hazards
	industrial	—PCBs —sludges —pesticides —paint —cleaners —photographic —acids —plastics —phenols —sulfur —asbestos —ammonia —cyanides —phosphates	—health hazards —danger to wild and aquatic life —carcinogenic (cancer causing)

WASTE MANAGEMENT PRACTICES

It has been said that, "Garbage is something everybody wants picked up, but nobody wants put down." Wastes, however, do have to be "put down." The basic principle of waste management is to ensure that disposed wastes do not cause environmental and health problems. This means that the *total loading* (amount and type) of wastes must be kept within the *carrying capacity* (ability to handle or assimilate wastes) in the environment.

In B.C., disposal in landfills is the most common solid waste management system. Solid waste material is spread in layers, compacted by bulldozers and covered with earth. Some solid wastes are burned in incinerators to reduce the volume. The forest industry burns wood wastes, also called *hog fuel*, to produce steam which is used to dry lumber, run equipment and, in many cases, generate electricity. At present, the forest industry uses hog fuel to provide about 56% of its energy requirements.

Liquid wastes must be treated to reduce the impact on the environment. There are three levels of treatment for liquid waste: *primary*, *secondary* and *tertiary*. While most communities in B.C. have primary and secondary facilities for treating sewage and industrial effluents, the lower mainland and coastal areas have only primary treatment facilities.

Industrial gaseous wastes are managed by using devices such as *scrubbers*, *electrostatic precipitators* and *cyclone collectors*, which reduce the levels of particulate and gaseous emissions. Tall smoke stacks disperse the cleaned gases to higher altitudes and larger areas to reduce the effect of any contaminants. Motor vehicle emissions are managed by using devices such as *catalytic converters*.

Special wastes may be managed by reusing them, recycling them to produce other materials, or treating (neutralizing) them on-site. One method of treatment is to solidify special wastes and then isolate them from the environment in a *secure landfill*. However, this is easier said than done. Many communities are reluctant to accept any facility which manages special waste.

WASTE MANAGEMENT PRACTICES

Waste Stream	Category	Type	Current Management Technique	Preferred Management Technique
Domestic	Solid	paper	dispose, recycle	reduce, recycle
		organics	dispose	compost
		glass	dispose, reuse	reuse, reduce, recycle
		metals	dispose, recycle	recycle
		residuals	landfill	landfill or other appropriate measure
	Liquid	sewage	treatment plant — discharge	reduce, treat, discharge
	Gaseous	car exhaust	discharge	reduce, use unleaded fuel
		heating units	discharge	reduce, increase air flow
	Special	motor oil others	dispose dispose	recycle deposit in depot
Industrial	Solid	wood waste	store, dispose, recycle	recycle to heat
		metals	dispose, recycle	recycle
		mine wastes	treat, store, dispose	recycle, dispose, increased treatment
		rubber, plastic	dispose	reuse, recycle
		residuals	dispose, landfill	landfill
	Liquid	effluents	treat, dispose	reduce, increased treatment
		chemicals	treat, dispose	reduce, reuse, recycle, exchange
		residuals	landfill	treat and dispose in landfill or other appropriate measure
	Gaseous	emissions	treat, discharge	reduce, increased treatment
	Special	chemicals	treat, dispose	recover, reuse, recycle, exchange, improved treatment
		heavy metals	recover, dispose	recover, reuse, recycle, exchange
		residuals	dispose	neutralize, solidify, dispose

COST OF WASTE MANAGEMENT

Each year, an estimated $100 million is spent to collect, transport, treat and dispose of the wastes produced in B.C. While some costs associated with waste management are *tangible* or measurable in monetary terms, others are *intangible* and, therefore, difficult or impossible to measure.

Tangible costs are incurred both *directly* and *indirectly*. For example, an industry incurs a direct cost when it installs a waste treatment system. Consumers pay an indirect cost when they buy the product manufactured by that industry because the cost of waste treatment is built into the price of the product.

The cost of municipal solid waste disposal varies with the size of the community, the distance to the landfill site and the level of service provided. In B.C., the estimated annual cost for the collection and disposal of nearly 1 million tonnes of municipal solid waste is from $45 to $60 per tonne (80% for collection and 20% for disposal).

The growing cost of waste management has prompted industry to find more effective methods of dealing with wastes, including reusing or recycling them or exchanging them with other industries through the *Canadian Waste Materials Exchange* program. This program helps companies that want to dispose of certain wastes and other companies that can use the wastes as *resources* in their industrial processes.

Although difficult to measure, intangible costs are nevertheless real. They include impacts to health caused by pollution, loss of environmental quality (e.g. contamination of soil and water from improperly stored chemicals), and loss of resource e.g. the death of fish due to acid rain).

EXAMPLES OF COSTS TO CONSUMERS OF DISCARDING WASTES

TANGIBLES		INTANGIBLES
Direct	Indirect	COSTS
cost of household waste management — garbage cans/bags	cost of garbage collection and disposal paid through taxes	loss of human health
cost of pollution equipment control in cars	cost of packaging is built into price of product	long term health effects of pollution: heavy metals, air and water pollution
	cost of industrial waste management is built into price of products	loss of clean air or water
	costs of energy production	long term environmental effects of pollution: lead, acid rain, photo-chemical smog, etc.
	opportunity value of land used for landfill sites*	loss of aquatic species and wildlife
	decrease in productivity of agricultural or forest land as a result of pollution	destruction of natural ecosystems: lakes, rivers, forests
	costs of clean-up	resource depletion
	increase in health service costs	

* In many cases, landfills can be used beneficially. Recreational facilities and buildings can often be constructed on the site after it is no longer being used as a landfill.

RESOURCE RECOVERY

Much of what we call garbage is really not waste at all. In fact, between one-third and one-half of all our wastes have some other potential use and should be considered resources rather than wastes. Three ways of improving waste management and optimizing the use of resources are the "Three R's":

- *reduce* the amount of waste generated in the first place (e.g., avoid buying overpackaged or disposable items);
- *reuse* items whenever possible (e.g., return refillable beverage containers so they can be reused);
- *recycle* old products to make new ones (e.g., recycle old newspapers to be repulped and made into new paper products).

After reusable and recyclable components have been removed from the waste stream, the remaining *residuals* (including plastics, packaging, fabrics, rubber and other materials) must still be disposed of in an appropriate way. The goal is to reduce the amount of residuals as much as possible.

(a) Cost of Resource Recovery

Recovering resources from the waste stream costs money. Recycling household wastes, for example, means increased labour costs for collecting, transporting, sorting and cleaning materials.

RECYCLABLE MATERIALS

Type	Resource	Recycled into:
Solid	Paper	Newsprint, paper cardboard, packaging home insulation
	glass	glass
	metal cans, scrap metal	other metal products
	rubber products	adhesives, rubber backing, retreated tires, asphalt, sports surfaces
	organic food & garden wastes	compost
	some plastics	other plastics
	food processing & farm wastes	animal feeds, fertilizers
	wood wastes	process heat
	textiles	new fabrics, flooring, roofing
Liquid & Special	oils, lubricants	oils, lubricants
	industrial chemicals and heavy metals	reprocessed and reused by other industries
	mine tailings	water is recycled
	pulping liquors	chemicals are recovered

Resource recovery also results in added costs to industry for activities such as removing toxic chemicals, heavy metals and heat from discharges. However, in the long term, resource recovery can save industry money.

(b) Benefits of Resource Recovery

Resource recovery has many benefits, both tangible and intangible. These include income from the sale of recyclable materials, cost savings to industry due to reduced requirements for raw materials, lower collection and disposal costs for communities, conservation of raw resources, energy conservation, reduced cost to produce goods, the opportunity to use land that would have been needed for landfill, reduced air, water and soil pollution, decreased health hazards and increased employment.

(c) Barriers and Incentives

Despite its many benefits, resource recovery is not yet widely practiced. One drawback is that companies and individuals are unfamiliar with waste management options. Another obstacle is people's reluctance to adopt new habits and technology.

It is generally agreed that incentives are needed to overcome the barriers and encourage resource recovery. These incentives might include progressive taxes, funds to start recycling centres, and the development of more cost-effective waste collection and transportation systems to serve communities. A major educational campaign is also needed to explain the full costs of our current waste management practices, the importance and benefits of resource recovery and methods for implementing them.

ROLES, RESPONSIBILITIES AND LEGISLATION

MODULE 1.9

Individuals, business, industry and government all have responsibilities and opportunities to manage wastes intelligently. Individuals can contribute to improved waste management by practising the three R's (reduce, reuse, recycle), becoming more discriminating consumers, educating others and participating in recycling projects.

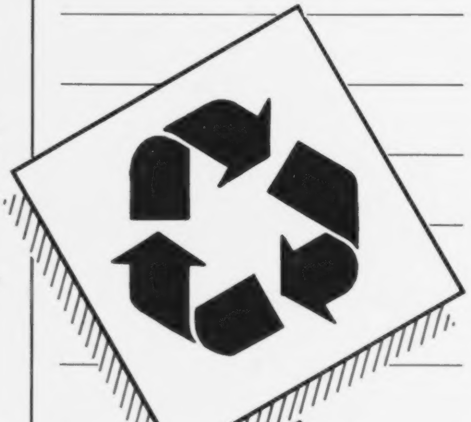
Industries often approach waste management in a more responsible manner than some individuals, partly because they are more heavily regulated. While some industries do "dump" wastes, many use good waste management practices such as recycling, resource recovery and waste exchange.

The federal, provincial and municipal levels of government each have different roles to play in waste management.

The federal government, through the Environmental Protection Service, promotes environmental quality and enforces protection requirements regarding environmental contaminants. The federal government also supports various programs designed to help reduce or reuse wastes.

The provincial government has the major responsibility for the management, treatment, transportation and disposal of wastes. The goal of the waste management program of the B.C. Ministry of Environment is "to manage waste materials for the protection of the environment and the conservation of energy and resources." It does this by regulating the discharge of wastes through a licensing system, monitoring effects of wastes on the environment, working to prevent and clean up spills of hazardous materials, providing an educational program and establishing pollution control guidelines for different industries.

The role of municipal government is to collect and dispose of solid and liquid domestic wastes in local areas and to support recycling programs. For example, the Municipality of Saanich on Vancouver Island has implemented a curbside collection progam to recycle paper, glass and metals.

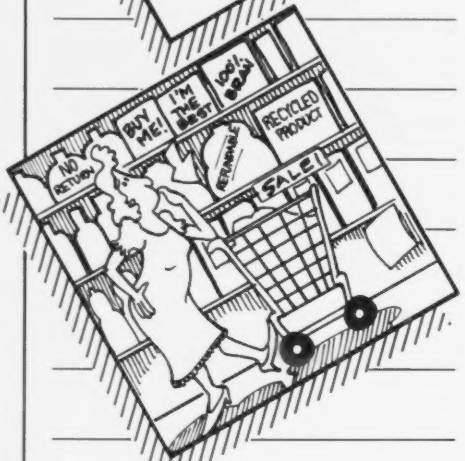


CONSUMER DECISIONS

People create waste problems and people can solve them. It is important to understand that our consumer decisions affect resource use and waste production.

The choices we make in the marketplace influence which products are sold, how they're packaged and how durably they are made. As some resources become scarcer and if waste management problems worsen, more individuals will consider these issues when making purchasing decisions.

The waste management issue is filled with *trade-offs*. How society decides to allocate funds and priorities depends on the perceived costs and benefits. Increased industrial pollution control can result in increased costs of products. This may affect the competitive position of industry in the marketplace. Are we willing to pay higher costs for products in order to reduce industrial pollution? Are we prepared to live with more legislation? Are we willing to do without wasteful packaging? It's up to society to decide if the extra costs now are worth the possible benefits later.



GETTING INVOLVED

Knowledge and desire are the tools needed to practise waste management. It can be done in your home, in your school and community.

At home you can separate garbage into its components for recycling, compost kitchen and garden wastes, reuse products, buy items that contain recycled materials and take used motor oil to designated service stations for recycling.

In school you can start a paper recycling project, then branch into recycling other materials.

In the community you can participate in recycling projects, whether they are organized on a curbside collection or a drop-off basis. You can tell your elected officials you support community involvement in source separation programs, composting of municipal sludge (the solids filtered from sewage in treatment plants which, when purified, make an excellent and safe fertilizer) and recovering of energy from wastes.

Ultimately, society must solve the problems associated with resource use and the management of wastes. The solution will undoubtably require a mix of technological and social changes including the reduction and reuse of waste products during manufacturing, political and economic support from government and industry, the standardization of recycling and handling solid wastes, and a change in the general public's attitude towards waste generation. The responsibility to implement the changes lies equally with individuals, industries and governments.

In British Columbia our wastes have not yet excessively harmed our air, water and land resources. We have the opportunity to deal effectively with our waste problems *before* they reach crisis proportions. Community education and public participation regarding waste management are essential. You can make a difference. Get involved.

Module One Terms

acid rain
carcinogenic
carrying capacity
catalytic convertor
concentration
consumers
cyclic
cyclone collectors
decomposers
direct costs
domestic waste stream
ecosystem
effluent
electrostatic precipitator
eutrophication
food chain
food web
gaseous waste
greenhouse effect
hog fuel
indirect cost
industrial waste stream
intangible cost
leach
leachate
linear
liquid waste
photochemical smog
photosynthesis
primary treatment
producers
quantity
recycle
reduce
residuals
resource
reuse
scrubbers
secondary treatment
secure landfill
solid waste
special waste
tangible
tertiary treatment
total loading
trade-offs
transformers
wastes

NOTES

MODULE #1 — QUESTIONS, PROJECTS AND ACTIVITIES

1. Define the following terms:
   - (a) ecosystem
   - (b) total loading
   - (c) carrying capacity
   - (d) resource
   - (e) residuals
   - (f) special waste
   - (g) recycle
   - (h) intangible cost
   - (i) food web
   - (j) domestic waste stream

2. Describe the role of, and relationships among, *producers*, *consumers* and *decomposers* in an ecosystem. Give at least two examples of each.

3. Molds are one type of decomposer. Set up a "mold garden" and predict what will happen to the various pieces of food matter placed in it:
   - (a) Get a metal can or plastic jar which is 15 cm to 20 cm in diameter and 7.5 cm to 10 cm deep.
   - (b) Put 2.5 cm of moist, loamy soil in the bottom of the container and pack it firmly. Make sure the soil is not saturated.
   - (c) Place up to 5 small pieces (0.5 to 0.8 cm in diameter) of food matter such as peelings, apple cores and stale bread on top of the soil.
   - (d) Cover the container with a thin sheet of clear plastic and hold in place with a rubber band. Twice a week, remove the cover for a few minutes in order to ensure an adequate supply of oxygen. Add sufficient water to keep the soil moist.
   - (e) Every second day, record what is happening in the mold garden and compare the results with your prediction.
   - (f) Explain the role which mold plays in the treatment of domestic wastes.

4. The wastes generated in our society can be classified in a number of ways.
   - (a) Identify the four major types of wastes generated in the *domestic* and *industrial* waste streams.
   - (b) Identify at least three major sources of wastes produced in the area where you live.
   - (c) Identify at least two problems associated with each of the different types of wastes.

5. Investigate and report to the class on at least three ways of accomplishing each of the following in the home:
   - (a) reducing waste
   - (b) reusing waste
   - (c) recycling waste

6. "Wastes" from some activities can be used as "resources" in another activity. Give at least two examples of how "wastes" from one producer are being used as "resources" by another in our society.

7. **The following is a teacher directed activity** — If there is a waste disposal site or waste treatment facility in your area, call the administration office and inquire about a tour. If a tour isn't possible, try to arrange for a speaker to come to class. Before taking a tour or listening to a speaker, it is important to:
   - (a) Discuss all phases of the waste disposal and treatment process as it relates to your local area.
   - (b) Arrange to have the tour or speaker follow the disposal/treatment in sequence if possible.
   - (c) Assign each student, or groups of students, specific tasks to be completed during, or immediately following, the tour or speaker.
   - (d) In the case of a tour, stress the importance of safety at all times.

8. Evaluate some of the possible environmental, social and economic consequences of the amount and concentration of wastes exceeding an ecosystem's carrying capacity.

9. The decisions you make as a consumer affect both resource use and waste production. Give some examples of how the foods you eat, the clothes you wear and the ways in which you spend your leisure time have an effect on resource use and waste production.

10. Identify, investigate and describe an example of an actual waste management problem in your area.
    (a) Describe the problem.
    (b) Did the problem present any potential health hazards?
    (c) What waste management techniques could have been used to alleviate the problem?
    (d) If the problem was resolved, describe how. If not, what are some of the on-going problems?

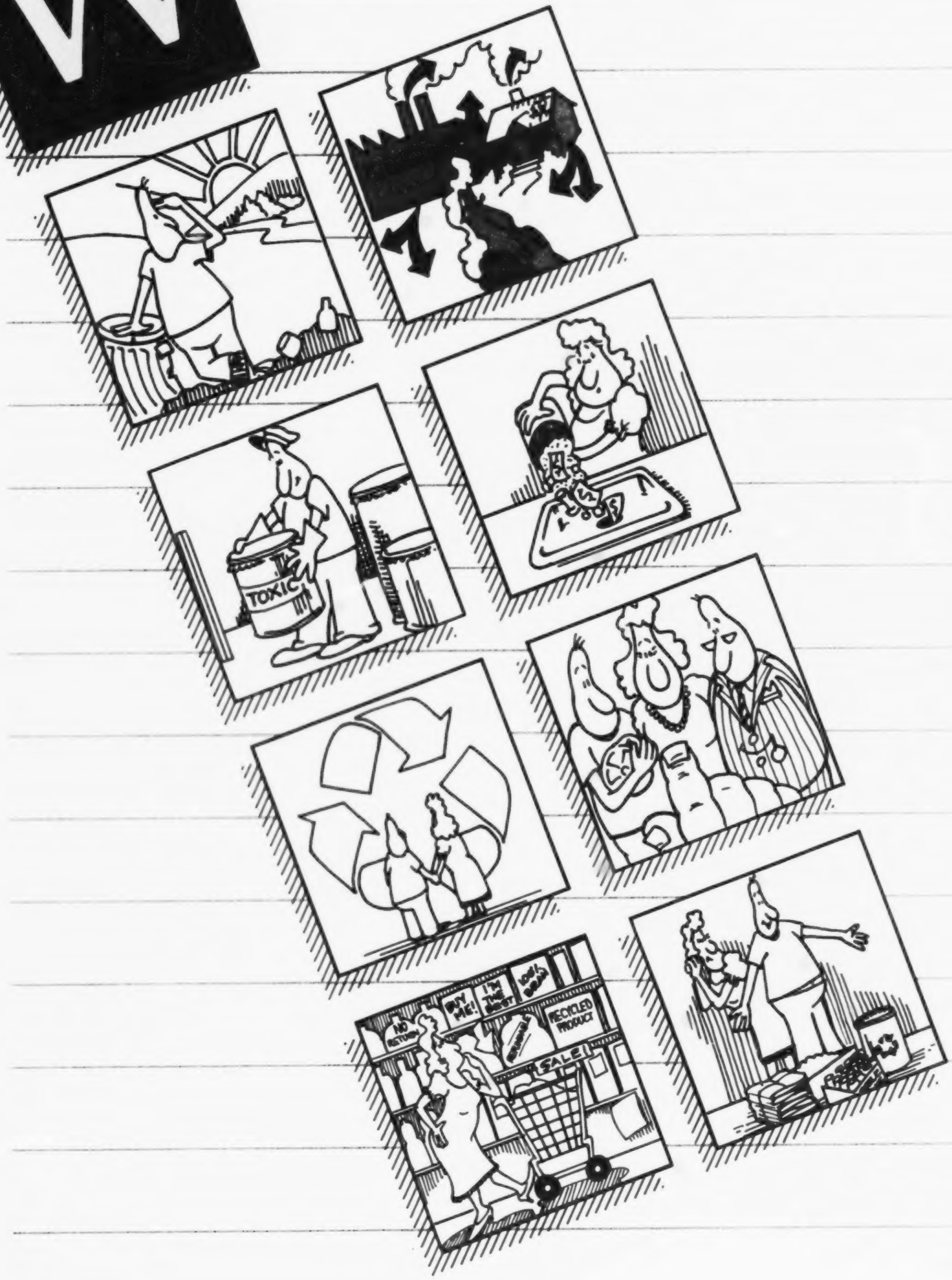
11. The variety and populations of animal species and people are controlled by the natural capacity of an area. Explore your community to determine:
    (a) What factors contribute to the carrying capacity of a bird or an animal population?
    (b) What factors contribute to the carrying capacity of a human population?
    (c) Compare and contrast the factors for each of the populations you have studied.
    (d) Investigate and explain why a carrying capacity may vary over time.

12. Resource use and development has greatly affected human history.
    (a) Compare the availability of resources and the ways they are used in industrialized and third world countries.
    (b) Explain how resource availability and use can affect a country's standard of living.

NOTES

MODULE #2

WASTE STREAMS



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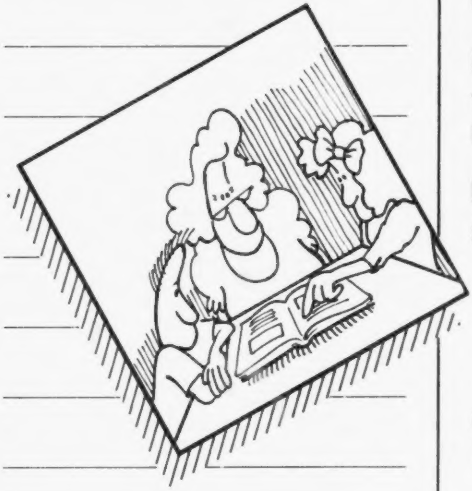
MODULE #2

WASTE STREAMS



SYNOPSIS

This module explores the various solid, liquid, gaseous and special wastes generated in the domestic and industrial waste streams as well as some of the impacts which different types of wastes can have on people and the environment.

PURPOSE

To understand various types of wastes, how they are generated and their potential impact on the environment.

LEARNING OUTCOMES

Students will be able to:

- (a) identify and describe the types and sources of wastes produced in the domestic and industrial waste streams.
- (b) describe and evaluate the effects of specific types of waste production on the environment.

CONTENT OUTLINE

1. Waste Streams (Domestic and Industrial)
    - (a) types of wastes produced by the domestic waste stream
        - — solid
        - — liquid
        - — gaseous
            - nitrogen oxides
            - hydrocarbons
            - carbon monoxide
        - — special
    - (b) types of waste produced by the industrial waste stream
        - — solid wastes
            - forestry
            - mining
            - manufacturing
            - agriculture
        - — liquid wastes
            - forestry
            - mining
            - petrochemical
            - agricultural and food processing
        - — gaseous wastes
            - metal smelting
            - petrochemical
            - pulp and paper
        - — special wastes

Suggested Use	Time Required
Science 10 Social Studies 10 Science and Technology 11 Gifted Students or Directed Studies Geography 12 Earth Science 11 Environmental Education	1–2 hours

Module 2 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports, and publications dealing with various aspects of waste production such as "Ozone: A Concern for Vancouver", *Environment Update,* Vol. 5, No. 4, April 1985.
2. The other teaching aids in the Waste and Resources package including: #1 "Resources and Wastes", #3 "Waste Management", #4 "Wastes Costs", #5 "Resource Recovery", #6 "Roles, Responsibilities and Legislation", #7 "Consumer Choices", #8 "Getting Involved".

MODULE #2 — REFERENCES AND RESOURCES

"Hazardous Wastes: Storing Up Trouble", Boraiko, A., National Geographic Magazine, Washington, D.C., March, 1985

Pollution Control Objectives (a series of pamphlets on different B.C. industries), B.C. Ministry of Environment, Victoria, B.C.

The Environment and the Pulp Mill, Weyerhauser Canada, Kamloops, B.C.

The Lower Mainland Refuse Project, Concepts Report, Greater Vancouver Regional District, Vancouver, B.C., 1984

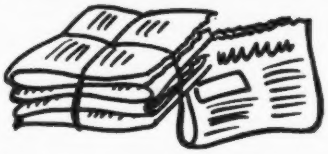
The Lower Mainland Refuse Report, Resource Recovery And Recycling, Greater Vancouver Regional District, Vancouver, B.C., 1984

"Watch on the Rain", Henry, B., Science Dimension, National Research Council Of Canada, Ottawa, Ontario, 1984

UPDATES

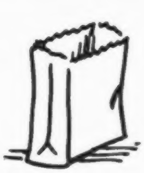
HOW AND WHAT TO RECYCLE

SOURCE SEPARATION — means setting aside recyclable materials like paper, cardboard, glass and metals from wastes in your household or business. Successful recycling depends on materials not being mixed with garbage or other types of recyclables.
FOR MORE INFORMATION CALL Ministry of Environment 387-4321.



Newspapers

Pile in 12″ bundles. Secure with twine. No magazines or phone books.

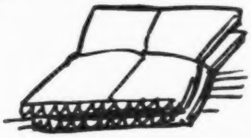


Brown Grocery Bags

No bags of other colors. Printing on bag OK. Bag or box.

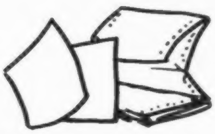
Magazines

Bundle or box.



Corrugated Cardboard boxes

Flatten, bundle, tie with twine. No cereal or shoe boxes, waxed or plastic-coated cardboard. Egg cartons OK.



Office Waste Paper

Includes white or colored ledger, computer paper and cards. Box or bag.

Glass

Rinse, remove lids, caps or neck rings. Paper labels OK. Color sort — green, brown, flint. Bag or box. No window glass, pyrex or drinking glass.

Bottles

Most pop and beer bottles returned for refunds. Depots which take them are listed in the Yellow Pages under *Bottles — Used*, or return to retail place of purchase.

Plastics

Recycling plastic waste is difficult especially on a small scale. Since no market exists it is best not to accumulate more plastic than you can *reuse* yourself. Plastic pop bottles can be returned for refund.

Tin Cans

Rinse, remove labels. Remove ends and put in with cans, flatten. Box or bag cans. No lids or bottle caps.

Aluminum

Clean and flatten, all foil, food and non-refundable beverage containers. No foil with paper adhering. Also recycle pots, pans, lawnchair frames, and kitchen utensils.

Other Metals

Household scrap which can be sold for recycling include household appliances, pipe, sheet metal, machinery parts, lead batteries and copper. A list of scrap metal dealers will be found in the Yellow Pages under *Scrap Metal*.

Used Motor Oil

Place in unbreakable, closed containers. Return to an **Oil Save** Depot.

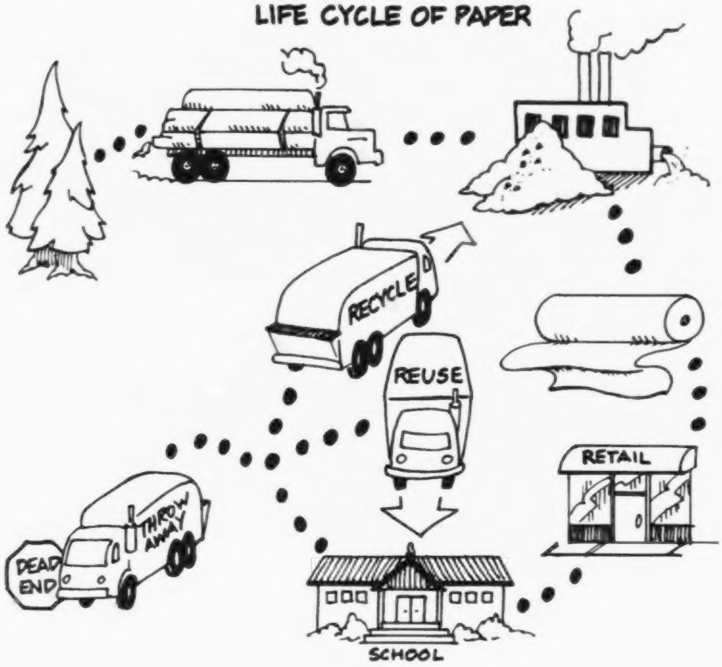
Food and Garden Waste

Food and garden wastes make up one-third of household waste. Composting is a means of processing these wastes into an enriching soil conditioner for your garden while diverting a significant amount of material from your community's solid waste stream. Information on how to compost is available from Waste Management Branch, Ministry of Environment or Horticulture Branch, Ministry of Agriculture.

WASTE STREAMS

No matter how small, each product leaves behind a trail of wastes as it is produced, packaged, transported, consumed and finally discarded.

This piece of paper, for example, began as a tree. When the tree was cut down, the chainsaw created exhaust and wood waste (bark, sawdust, tops, limbs, etc.). The tree was then transported to a pulp mill on a truck which generated exhaust. The pulp and paper mill produced both liquid and gaseous wastes in the process of turning the wood into paper. The paper was packaged and shipped to market. When this piece of paper is finally discarded, a garbage truck will pick it up and transport it to the dump. At every step, wastes are generated.



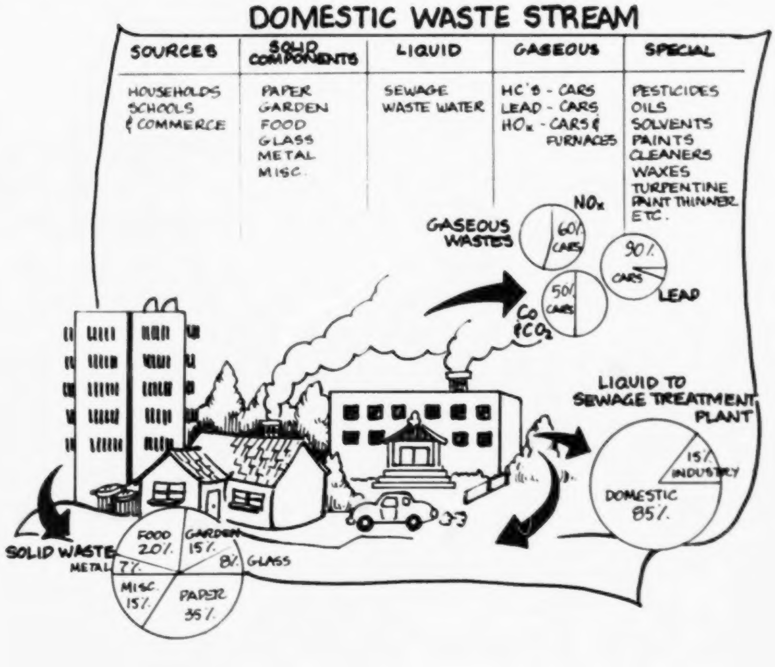
> Paper products such as newsprint, brown paper and corrugated cardboard represent the largest portion (in both weight and volume) of material in the municipal solid waste stream. People in the Lower Mainland alone discard about 100 000 tonnes per year, which is equal to a stack of newspapers almost 3 kilometres high. If more of this waste was separated and recycled, disposal problems would be reduced and fewer trees would have to be cut to meet our need for new paper products.

The various types of wastes which are generated can be divided into two streams: *domestic* and *industrial*.

MODULE 2.2

DOMESTIC WASTE STREAM

The domestic waste stream includes all of the wastes generated by individuals at home, school and work. These can be divided into four major categories: (1) solid; (2) liquid; (3) gaseous; and (4) special wastes.



1. SOLID WASTE

Domestic solid waste consists of the following materials:

Paper — includes newspapers, cardboard, boxes, packaging, brown paper and fine paper (about 35% of domestic solid wastes).

Food — includes organic kitchen wastes from households, restaurants and cafeterias (about 20% of domestic solid wastes).

Garden — includes lawn cuttings and plant prunings (about 15% of domestic solid wastes)

Glass — includes bottles and jars (about 8% of domestic solid wastes).

Metal — includes tin and aluminum cans, broken or obsolete toys, appliances, junked automobiles and other metal items (about 7% of domestic solid wastes).

Miscellaneous — includes the remainder, which is composed of plastics, textiles, leather, dirt, etc. (about 15% of domestic solid wastes).

The majority of domestic solid wastes are generated by households. Packaging — bottles, cans, tins, cardboard, plastic, jars and other containers — makes up about 30% of standard household garbage. Because most domestic waste is hauled away regularly, people are often unaware of what happens after it leaves their homes. In most cases, domestic solid waste is collected by the municipality and transported to an incinerator or landfill site.

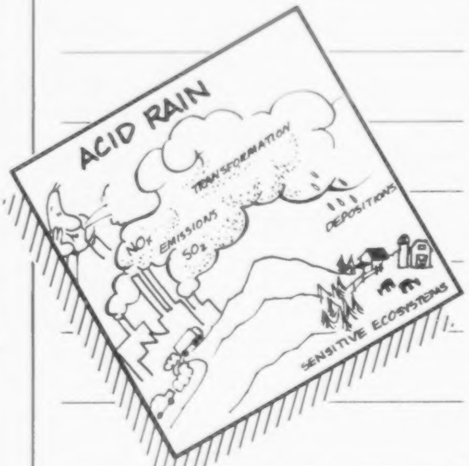
2. LIQUID WASTE

The domestic waste stream also includes a variety of liquid wastes. In British Columbia about 250 billion litres of liquid waste are produced yearly. Every time people drain their sinks, take a shower or flush their toilets, they contribute *sewage* to the municipal *sewerage system*. On average, about 85% of sewage processed in a typical treatment facility comes from domestic sources while the remaining 15% is produced by industry. Liquid wastes discharged into the environment, usually after some treatment, are known as *effluents*.

> Note — Municipal effluents reduce the supply of oxygen in the receiving waters. They also contain solids in suspension which can blanket and kill life in stream sediments. They contain *pathogens*, which may spread disease depending on the health of the contributing population. Organic wastes such as manure, and chemicals such as phosphates and nitrates, are *nutrients* for other plant life. When these wastes enter fresh water in such a way that the total amount exceeds the carrying capacity, a process called *eutrophication* occurs. The nutrients are the first step in the food chain and excessive amounts cause increased growth of the second link in the chain, a microscopic plant called *photoplankton*. The photoplankton population then grows so large that it consumes almost all of the oxygen in the water, thereby suffocating other forms of life. While the ecosystem may eventually adapt, eutrophication can be the first step in the *succession* of a pond or lake into a swamp marsh or bog.

3. GASEOUS WASTE

Another part of the domestic waste stream is gaseous. Cars, trucks and home heating units are directly responsible for the production of large amounts of gaseous wastes. In metropolitan areas, cars and trucks are a major cause of air pollution. The main pollutants in vehicle exhaust are nitrogen oxides, hydrocarbons, carbon monoxide and, in the case of older cars, lead.



(a) Nitrogen Oxides

About 60% of all nitrogen oxides are produced by vehicles. The other 40% comes from residential heating units and industrial sources. When nitrogen oxides combine chemically with the moisture in the atmosphere, they increase the acidity of rain. In turn, acid rain can destroy life in small lakes and adversely affect the productivity of soils.

(b) Hydrocarbons

Inefficient combustion in engines results in the release of unburned hydrocarbons. Under sunlight, hydrocarbons and nitrogen oxide combine to produce *photochemical smog*.

The principal component of photochemical smog is *ozone*. It is formed by a chemical reaction in the air from combinations of hydrocarbons, nitrogen oxides and sunlight. Ozone can irritate the respiratory system, causing coughing and impairing lung functions. It can also damage plants and vegetation and cause rubber to crack and dyed fabrics to fade.

(c) Carbon Monoxide

When fossil fuels are burned, carbon monoxide is also released. This colourless, odourless gas causes problems for animals and humans because it interferes with the blood's capacity to absorb oxygen.

(d) Lead

Older vehicles still use leaded gasoline. The lead in leaded gasoline acts as a lubricant and octane enhancer. However, because lead does not burn, it is released into the atmosphere through the exhaust pipe. Lead accumulates in the body tissues of animals and people. Excessive levels can cause brain damage, especially in children.

Home heating units, particularly wood heaters and fireplaces, can also diminish air quality. This is a concern in communities where many homes are heated with wood. During calm weather, localized air pollution can accumulate because the smoke is not dispersed by wind.

4. SPECIAL WASTES

The fourth component of the domestic waste stream involves *special wastes*. Many people think of special wastes as something generated by industry, but it is important to recognize that households also produce a number of special wastes. Example's of household special wastes include:

— used motor oil
— turpentine
— cleaners
— stains
— medicines
— dyes
— paint thinner
— pesticides
— antifreeze
— paint
— battery acid

Because of their potentially hazardous nature, special wastes require special handling. Consequently, if they are dumped into drainage systems or sent to landfills, then special waste problems can result.

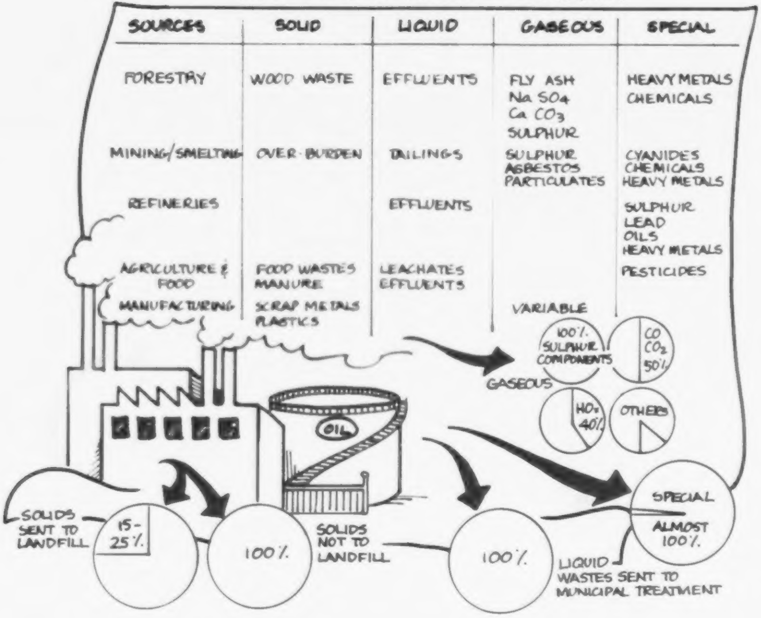
INDUSTRIAL WASTE STREAM

The industrial waste stream is much more diverse than the domestic stream. Most domestic solid and liquid wastes end up in landfill sites or sewage treatment plants. However, many industrial wastes must be treated, or disposed of, on-site. Because of the costs of on-site treatment or disposal, industries have a direct incentive to reduce the amount of wastes they produce.

The disposal of any industrial liquid, solid, gaseous or special waste requires a permit from the provincial government. Under these permits the applicant must undertake a regular sampling and monitoring program. A report on sample analysis must be submitted to the Ministry of Environment each month.

In B.C., wastes are generated by resource industries, such as forestry and mining, as well as the manufacturing and agricultural sectors.

INDUSTRIAL WASTE STREAM



SOURCES	SOLID	LIQUID	GASEOUS	SPECIAL
FORESTRY	WOOD WASTE	EFFLUENTS	FLY ASH $NaSO_4$ $CaCO_3$ SULPHUR	HEAVY METALS CHEMICALS
MINING/SMELTING	OVER-BURDEN	TAILINGS	SULPHUR ASBESTOS PARTICULATES	CYANIDES CHEMICALS HEAVY METALS
REFINERIES		EFFLUENTS		SULPHUR LEAD OILS HEAVY METALS
AGRICULTURE & FOOD	FOOD WASTES MANURE	LEACHATES EFFLUENTS		PESTICIDES
MANUFACTURING	SCRAP METALS PLASTICS		VARIABLE	

1. SOLID WASTE

A variety of solid wastes are generated by forestry, mining, manufacturing and agricultural industries.

(a) Forestry

B.C.'s forestry industry generates about 8–9 million tonnes of wood wastes (sawdust, shavings and bark) each year. At present, about half of the wood waste produced is used to meet part of the forest industry's energy needs. The remainder is either burned or dumped in landfills. If all of the wood waste produced by the forest industry was converted into heat, it would represent the energy equivalent of almost 3 million cubic metres (18 million barrels) of oil.

(b) Mining

Most minerals are found in concentrations of less than 1% (precious metals such as silver and gold can be produced economically at concentrations of less than (0.1%). This means that more than 90% of the materials processed by mining operations are waste. Mine wastes generally fall into two categories: *rock wastes* and *tailings*. Rock wastes or *overburden* are usually piled up in huge quantities on the mining site. Because they are generally *inert*, rock wastes do not normally cause environmental problems. Although rock wastes could be used to fill a hole created by mining activity when the minerals are exhausted, they are usually left as is.

Tailings are the wastes which are produced when ore is processed. They normally take the form of *slurry* which consists of water, chemicals and suspended solids. Because of their liquid nature, tailings are commonly managed as a liquid rather than a solid waste.

(c) Manufacturing

Thousands of tonnes of scrap metal are generated in B.C. each year. While a small amount of scrap metal comes from domestic sources, the majority is produced by industry. Industrial metal wastes can be broken down into the following types:

- — aluminum, lead and brass
- — miscellaneous metals such as pipes, rolled steel, sheet metal, metal plate and structural metals
- — steel wire
- — iron
- — stainless steel
- — spring metal

Many types of scrap metal can be reused to produce new metal products. At present scrap metal supplies about one-third of the North American steel industry's resource needs.

(d) Agriculture

The fourth type of industrial solid waste is generated by agricultural and food processing industries. Farm wastes are *organic* and consist primarily of animal manure and crop residues. Most manure is used to fertilize fields, while most crop residues are plowed under or converted to animal feed. If the manure or chemical fertilizer which is placed on a field exceeds its carrying capacity, then part of it can find its way into water sources and contribute to the eutrophication of lakes, ponds and marshlands in the area.

Food processing wastes are usually dumped in landfill sites or converted into garden fertilizers and animal feeds.

2. LIQUID WASTE

The primary source of liquid industrial wastes are pulp and paper mills, mines and smelters, food plants and petroleum refineries.

(a) Forestry

About half of B.C.'s pulp and paper mills are in the Interior and discharge treated effluents into rivers. Coastal mills generally discharge treated effluents into the ocean. Of the two dozen pulp and paper mills in B.C., all use some form of chemical extraction to make pulp and paper. A number of processes, such as kraft, sulphite, mechanical and thermo-mechanical are used. The pulp produced from one tonne of logs varies from approximately one-half tonne for kraft pulp to nine-tenths of a tonne with thermo-mechanical. The remainder is waste material which must be processed.

Some of the waste material is burned in recovery boilers to produce energy and to recover chemicals. The remaining liquid residues are sent to waste water treatment facilities before being discharged to the environment.

Only about half of the water used in the pulping process is recycled within the mill before being released. While kraft and sulphite mills use roughly 150 cubic metres of water to process one tonne of finished product, thermo-mechanical mills use about one-tenth of this amount.

Pulp effluents contain:

- organic materials which consume oxygen as they decompose, depleting the supply available for life in the receiving waters (Biochemical Oxygen Demand or B.O.D.).
- toxic (poisonous) elements including resin acids, fatty acids, sulfides, phenols and mercaptans.
- suspended solids including organic materials such as cellulose and inorganic materials such as fly ash and calcium carbonate.

(b) Mining and Smelting

Liquid wastes from mining are primarily in the form of tailings. Tailings are the wastes created when the ore or mineral-bearing rock is processed and the valuable components are removed. This processing often uses large quantities of water and, in the case of gold and other precious metals, cyanide and other chemicals. The resulting wastes consist of water, suspended solids and some chemicals. They are stored in areas called *tailing ponds* where the solids settle to the bottom. The water on the surface of the tailing ponds is then reused. Tailing ponds can become acidic. Therefore, any leaching from a tailing pond into the environment can be hazardous to fish, wildlife and humans in the area.

Smelter operations in B.C. process millions of tonnes of ore in order to produce aluminum, iron, lead, zinc, gold, silver and other metals. In the process, they produce effluents which contain:

- suspended solids including traces of metals such as aluminum, cadmium, lead and copper.
- dissolved solids including dissolved metals and water-soluble chemical compounds.
- toxic elements including arsenic, cyanide, mercury and ammonia.

(c) Petrochemical Industry

The petrochemical industry in B.C. produces a wide variety of products such as gasoline and other fuels, lubricants, resins, paints, petrochemicals and plastics. Processing petroleum products does not generally require large amounts of water. Although the amount of effluents produced is not very large, the liquid wastes can contain many potentially hazardous compounds including:

— oils
— ammonia
— chromium
— copper
— phenols
— solids
— lead
— nickel
— sulphides and mercapatans
— cyanide
— zinc
— phosphates

(d) Agriculture and Food Processing

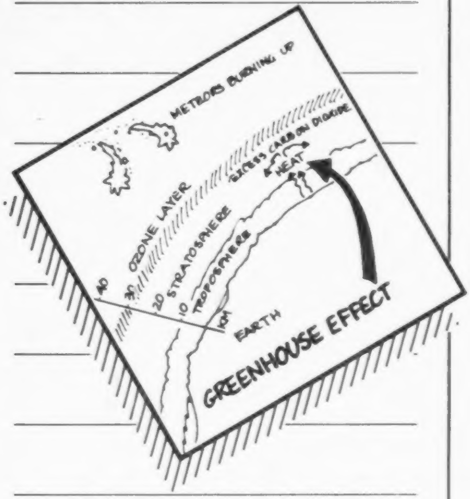
There are many food-related industries in B.C. including:

— fish canning
— fish processing
— poultry raising
— poultry processing
— dairy processing
— food processing and packaging
— fruit and vegetable processing
— meat production
— meat processing
— breweries and distilleries
— soft drink bottlers

Although the majority of wastes produced by this sector are *organic* and therefore *biodegradeable*, they are produced in large amounts. If food processing wastes are released into the environment in large concentrations, over-enrichment and eutrophication of water sources can result.

3. GASEOUS WASTE

In British Columbia, the total gaseous emissions of contaminants from man-made sources amounts to more than 2.5 million tonnes per year. Of this total, at least 40% is caused by transportation.



Gaseous wastes from industries powered by fossil fuels consist primarily of *particulates* and chemical compounds such as sulphur dioxide and nitrogen oxides. These two chemical compounds can result in *acid rain.* Over a period of time, acid rain can destroy aquatic life and seriously reduce the productivity of soil.

> Acid rain is becoming a serious environmental problem in some parts of the world. In parts of Eastern North America and industrialized Europe the problem has become critical. In Eastern Canada and the United States, for example, thousands of lakes and other waterways are effectively "dead" because of acid rain. In addition, recent studies have indicated the rain falling on the southwestern coast of B.C. is more acidic than normal and may eventually cause problems here.

Another gaseous waste caused by the burning of fossil fuels is carbon dioxide. When too much carbon dioxide is present, it can accumulate in the upper reaches of the atmosphere and form a barrier which may trap heat. This results in what is known as the *greenhouse effect* — it can cause the temperature on earth to rise. The increased temperature could have detrimental effects such as enlarging the earth's arid regions and melting some of the ice caps, thereby raising water levels in the oceans and flooding coastal areas.

The main sources of industrial gaseous wastes are metal smelting, petroleum refining and pulp and paper processing.

(a) Metal Smelting

Metal smelting is the largest producer of sulphur dioxide. In fact, 90% of monitored compounds are sulphur-based, although particulates and metal elements are also emitted.

(b) Petrochemical Industries

The principal gaseous wastes produced by the petrochemical industry are hydrocarbons and sulphur compounds. Nitrogen oxides, carbon monoxide, ammonia and aldehydes are also produced.

(c) Pulp and Paper Processing

Chemical pulp mills recover about 96% of the chemical components used in the pulping process by burning the so-called *black liquor* in recovery furnaces. However, the emissions which result from this and other processes are mainly composed of particulates including fly ash, sodium sulphate and calcium carbonate. A small amount of chlorine and total reduced sulphur compounds are also produced.

> Gaseous wastes are dispersed into the earth's atmosphere which is fragile and limited. If the earth was a globe 46 centimetres in diameter, then the depth of the troposphere (the life-sustaining lower 10 to 20 kilometres of the atmosphere) would be a narrow band about as wide as a human hair.

4. SPECIAL WASTES

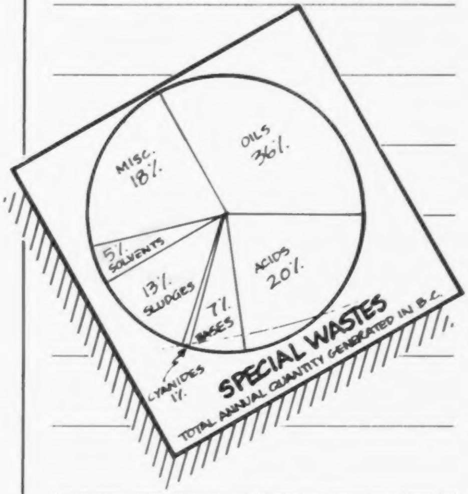
Most of the estimated 74 000 tonnes of special wastes generated by industry each year in B.C. are produced by the metallurgical, chemical, petroleum, pulp and paper industries. Almost 80% of these special wastes are generated in the Greater Vancouver area.

The following table summarizes the recent data (1984) on the amount of annual special waste generation rates in the province:

Special Waste in British Columbia

	Tonnes yr	% of Total Production
Acids	14 850	20%
Bases	5 400	7%
Oils	26 450	36%
Solvents	3 350	5%
Cyanides	650	1%
Sludges	10 000	13%
Miscellaneous*	13 400	18%

* chemicals, paint, pesticides, tannery wastes, PCBs, "tank bottoms", radioactive elements



Farms use a variety of pesticides and other chemicals to grow foods. If an accident occurs, significant amounts of pesticides could be released and overload the carrying capacity of the environment, causing a pollution problem. In addition, people often carelessly handle pesticides or don't read the labels.

In British Columbia, most domestic solid wastes end up in landfills or incinerators, while most liquid wastes are discharged into bodies of water after going through sewage treatment plants. On the other hand, many industrial wastes are treated and disposed of on-site. The disposal of any industrial special wastes requires a permit from the Ministry of Environment.

In the years ahead, we must find ways of reducing both the amount of wastes we produce and their negative affects on the environment.

Module Two Terms

acid rain
black liquor
biodegradeable
domestic waste stream
eutrophication
gaseous waste
greenhouse effect
industrial waste stream
inert
liquid waste
nutrients
organic
overburden
ozone
particulate
pathogen
photochemical smog
photoplankton
rock waste
sewage
sewerage system
slurry
solid waste
special waste
succession
tailings

NOTES

MODULE 2.10

MODULE #2 — QUESTIONS, PROJECTS AND ACTIVITIES

1. Define the following terms:
   - (a) effluents
   - (b) sewage
   - (c) photochemical smog
   - (d) tailing ponds
   - (e) greenhouse effect
2. The wastes generated by our society can be classified in a number of ways.
   - (a) Identify the four major types of wastes generated in the *domestic* and *industrial* waste streams.
   - (b) Give at least three examples of wastes produced in each stream.
   - (c) Identify at least three major sources of industrial waste in your community.
3. Select a manufactured item and develop a flow chart on which you describe the steps in its "life cycle".
4. Determine the types and sources of air contamination in your community and suggest ways each might be reduced or eliminated.
5. This is a teacher directed activity. The B.C. Ministry of Environment operates a laboratory where air, water, soil and tissue samples are analyzed. Arrangements can be made for students to take samples in their area and send them to the laboratory for analysis. Teachers interested in such a class project should do the following:
   - (a) Obtain an information kit by writing to:

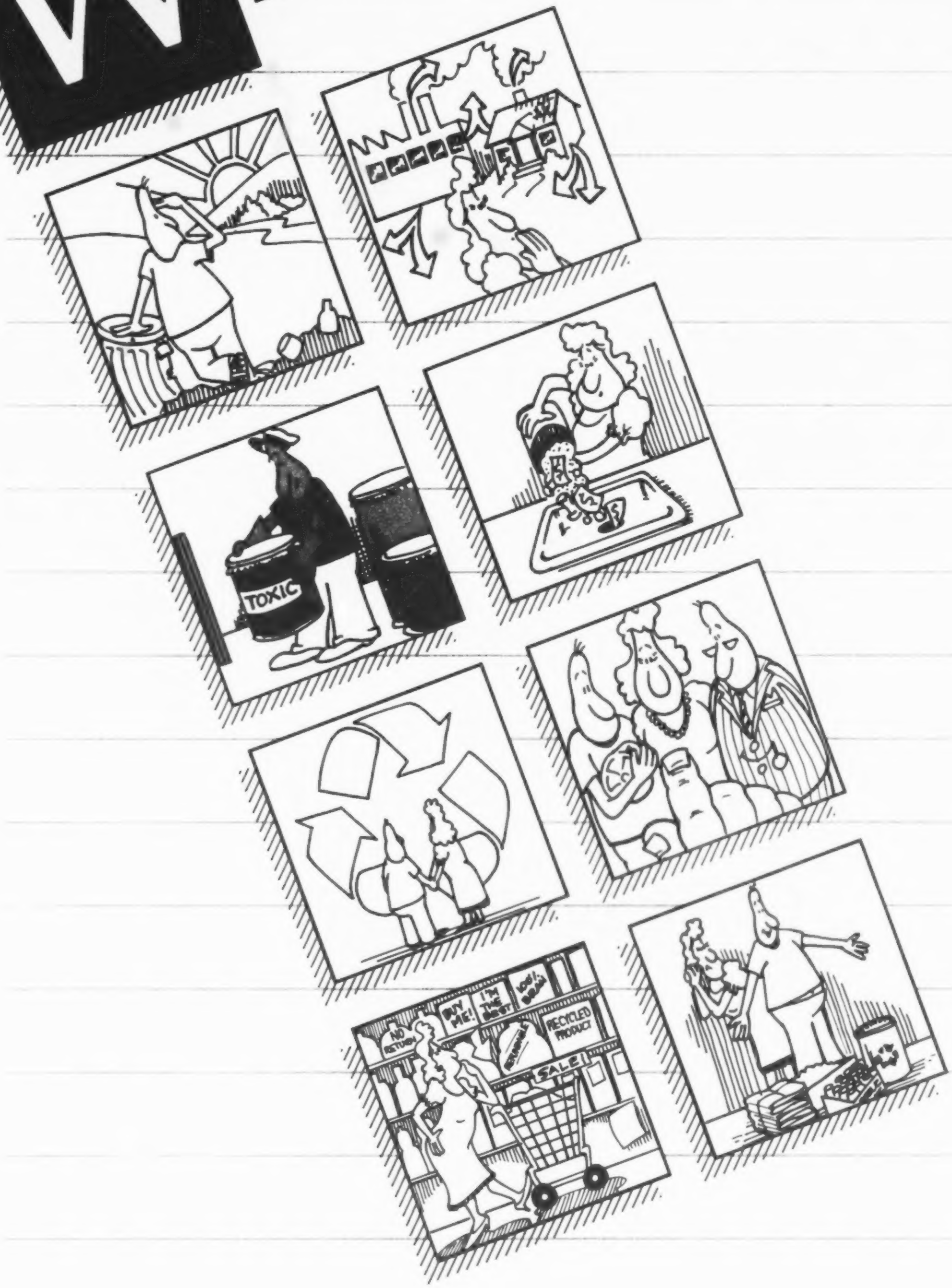
     B.C. Ministry of Environment
     Environmental Lab
     3650 Westbrook Crescent
     Vancouver, B.C. V6S 2L2

   - (b) Based on the instructions presented in the information kit, collect air, water, soil and/or tissue samples and send to the laboratory for analysis.

NOTES

MODULE #3

WASTE MANAGEMENT



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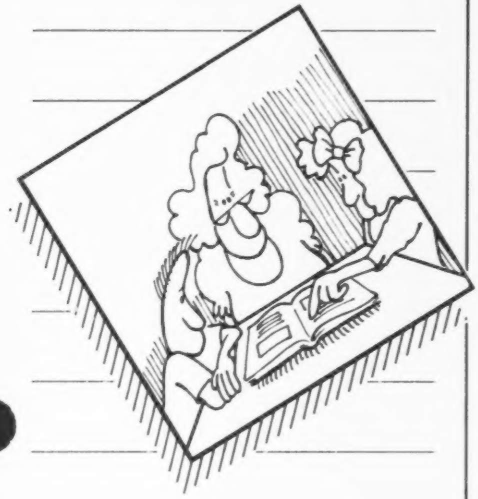
TEACHER'S PAGE

MODULE #3

WASTE MANAGEMENT



SYNOPSIS

The first section of this module explores waste management techniques. It is followed by a discussion of how resources can be recovered from wastes and recycled and reused. The module ends with a section outlining the benefits of improved waste management.

PURPOSE

To understand the various methods for handling different types of wastes — present and future.

LEARNING OUTCOMES

Students will be able to:

- (a) list current disposal methods used for solid, liquid, gaseous and special wastes
- (b) report on the solid waste management methods used in their community
- (c) identify and compare alternative strategies for waste reduction, reuse, recycling and recovery
- (d) identify and evaluate some of the longer-term environmental consequences of improved waste management practices

CONTENT OUTLINE

1. Current Waste Management Methods
    - (a) solid wastes
    - (b) liquid wastes
    - (c) gaseous wastes
    - (d) special wastes
2. Improved Waste Management Practices
    - (a) reduce, reuse, recycle
    - (b) how recovered materials can be used for packaging, paper, building materials, etc.
3. Benefits of Improved Waste Management
    - (a) keep total loading of waste within carrying capacity
    - (b) reduce demand on other resources and optimize resource use
    - (c) reduce negative impacts on health, wildlife, etc.
    - (d) reduce energy demands

Suggested Use	Time Required
Science 10	1–2 hours
Social Studies 10	
Environmental Education	
Earth Science 11	
Science and Technology 11	
Geograph 12	

Module #3 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports and publications dealing with various aspects of resource recovery and use such as "New Underground Treatment System Reduces Land Requirements", *Water and Pollution Control*, February, 1985.

2. The other teaching aids in the Resources and Wastes package including; #1 "Resources and Wastes" #2 "Wastes Streams", #4 "Wastes Costs", #5 "Resource Recovery",
#6 "Roles, Responsibilities and Legislation", #7 "Consumer Choices" and #8 "Getting Involved".

MODULE #3 — REFERENCES AND RESOURCES

"Hazardous Wastes: Storing Up Trouble", Boraiko, A., National Geographic Magazine, Washington, D.C., March, 1985

Pollution Control Objectives (a series of pamphlets on different B.C. industries), B.C. Ministry of Environment, Victoria, B.C.

The Environment and the Pulp Mill, Weyerhauser Canada, Kamloops, B.C.

The Lower Mainland Refuse Project, Concepts Report, Greater Vancouver Regional District, Vancouver, B.C., 1984

The Lower Mainland Refuse Report, Resource Recovery And Recycling, Greater Vancouver Regional District, Vancouver, B.C., 1984

"*Watch on the Rain*", Henry, B., Science Dimension, National Research Council Of Canada, Ottawa, Ontario, 1984

UPDATES

HOW AND WHAT TO RECYCLE

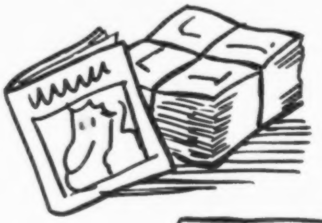
SOURCE SEPARATION — means setting aside recyclable materials like paper, cardboard, glass and metals from wastes in your household or business. Successful recycling depends on materials not being mixed with garbage or other types of recyclables.
FOR MORE INFORMATION CALL Ministry of Environment 387-4321.

Newspapers

Pile in 12" bundles. Secure with twine. No magazines or phone books.

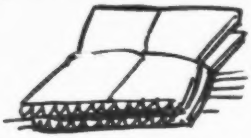
Brown Grocery Bags

No bags of other colors. Printing on bag OK. Bag or box.



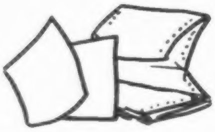
Magazines

Bundle or box.



Corrugated Cardboard boxes

Flatten, bundle, tie with twine. No cereal or shoe boxes, waxed or plastic-coated cardboard. Egg cartons OK.



Office Waste Paper

Includes white or colored ledger, computer paper and cards. Box or bag.

Glass

Rinse, remove lids, caps or neck rings. Paper labels OK. Color sort — green, brown, flint. Bag or box. No window glass, pyrex or drinking glass.

Bottles

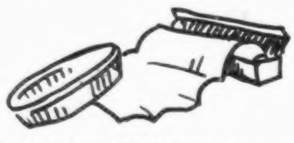
Most pop and beer bottles returned for refunds. Depots which take them are listed in the Yellow Pages under *Bottles — Used*, or return to retail place of purchase.

Plastics

Recycling plastic waste is difficult especially on a small scale. Since no market exists it is best not to accumulate more plastic than you can *reuse* yourself. Plastic pop bottles can be returned for refund.

Tin Cans

Rinse, remove labels. Remove ends and put in with cans, flatten. Box or bag cans. No lids or bottle caps.



Aluminum

Clean and flatten, all foil, food and non-refundable beverage containers. No foil with paper adhering. Also recycle pots, pans, lawnchair frames, and kitchen utensils.

Other Metals

Household scrap which can be sold for recycling include household appliances, pipe, sheet metal, machinery parts, lead batteries and copper. A list of scrap metal dealers will be found in the Yellow Pages under *Scrap Metal*.

Used Motor Oil

Place in unbreakable, closed containers. Return to an **Oil Save** Depot.

Food and Garden Waste

Food and garden wastes make up one-third of household waste. Composting is a means of processing these wastes into an enriching soil conditioner for your garden while diverting a significant amount of material from your community's solid waste stream. Information on how to compost is available from Waste Management Branch, Ministry of Environment or Horticulture Branch, Ministry of Agriculture.

WASTE MANAGEMENT

The basic principle of effective waste management is to ensure that wastes do not cause environmental and health problems when they are disposed of or treated. Consequently, the type and concentration of wastes must be such that the environment can decompose, assimilate and absorb them. This is referred to as keeping the *total loading* of wastes within the *carrying capacity* of the environment.

Total loading is a function of the type, quantity and concentration of wastes released over a specific period of time. The ideal waste management system maintains the balance and does not exceed the environment's carrying capacity.

In British Columbia, the discharge of any solid, liquid, gaseous or special waste requires a permit from the provincial government. Each permit specifies the types and amounts of wastes which can be released and also stipulates a monitoring program to help ensure the limits are not exceeded.

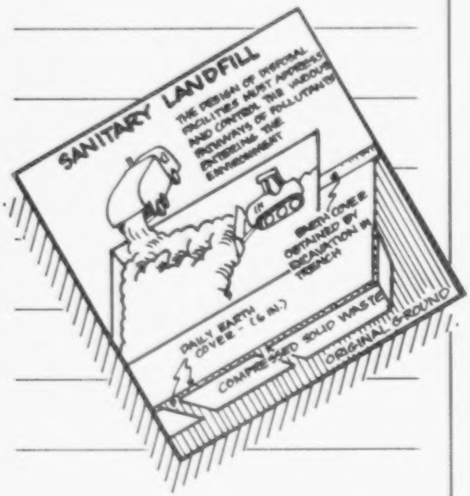
A variety of techniques are currently used for solid, liquid, and gaseous waste management. In addition, there are a number of ways in which our waste management practices could be improved.

Waste Stream	Category	Type	Current Management Technique	Preferred Management Technique
Domestic	Solid	paper	dispose, recycle	reduce, recycle
		organics	dispose	compost
		glass	dispose, reuse	reuse, reduce, recycle
		metals	dispose, recycle	recycle
		residuals	landfill	landfill or other appropriate measure
	Liquid	sewage	treatment plant — discharge	reduce, treat, discharge
	Gaseous	car exhaust	discharge	reduce, use unleaded fuel
		heating units	discharge	reduce, increase air flow
	Special	motor oil others	dispose dispose	recycle deposit in depot
Industrial	Solid	wood waste	store, dispose, recycle	recycle to heat
		metals	dispose, recycle	recycle
		mine wastes	treat, store, dispose	recycle, dispose, increased treatment
		rubber, plastic	dispose	reuse, recycle
		residuals	dispose, landfill	landfill
	Liquid	effluents	treat, dispose	reduce, increased treatment
		chemicals	treat, dispose	reduce, reuse, recycle, exchange
		residuals	landfill	treat and dispose in landfill or other more appropriate measure
	Gaseous	emissions	treat, discharge	reduce, increased treatment
	Special	chemicals	treat, dispose	recover, reuse, recycle, exchange, improved treatment
		heavy metals	recover, dispose	recover, reuse, recycle, exchange
		residuals	dispose	neutralize, solidify, dispose

1. SOLID WASTE MANAGEMENT

The three principal methods of solid waste management are *landfill*, *incineration* and *materials recovery*.

Although there are differences among the solid waste disposal options, they all have one thing in common: no one wants to live near any of the disposal sites. This makes site selection a difficult process.


SANITARY LANDFILL
THE DESIGN OF DISPOSAL FACILITIES MUST APPRECIATE AND CONTROL THE VARIOUS PATHWAYS OF POLLUTANTS ENTERING THE ENVIRONMENT
EARTH COVER OBTAINED BY EXCAVATION IN TRENCH
DAILY EARTH COVER - (6 IN.)
COMPRESSED SOLID WASTE
ORIGINAL GROUND

(a) Landfill

Disposal in *sanitary landfills* is the most common solid waste management and disposal system used in B.C.

Approximately one-third of all the solid wastes disposed of in a typical municipal landfill site is produced by industry. Most industrial solid wastes, however, are handled on industrial sites.

In sanitary landfills, the waste material is spread out in layers, compacted by bulldozers then covered with earth. The following chart outlines the advantages and disadvantages of sanitary landfills.

Sanitary Landfill

Advantages	Disadvantages
— low cost	— require much land
— easy to manage	— leachates can be created by rain draining through the fill
— may be used to reclaim marginal land for parks, etc.	— leachates may enter ground water affecting wells and springs
— seals in odour	— decomposition of materials can create methane gas (a fire or explosion) hazard
— can receive most types of wastes	
— litter is covered	

In small landfills the waste material is simply deposited and infrequently covered with soil. The following chart outlines the advantages and disadvantages of small landfills.

Small Landfills

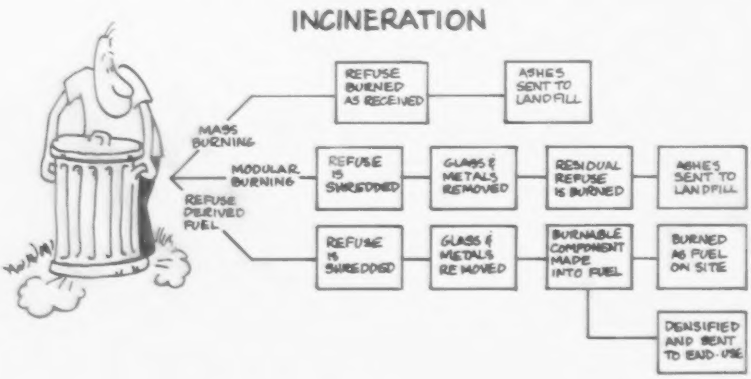
Advantages	Disadvantages
— very inexpensive and easy	— open to insects and wildlife
	— create leachates
	— create foul odours
	— can create fire hazards and cause air pollution if items are burned

It should be noted that proper landfill design can help reduce the disadvantages associated with landfills.

(b) Incineration

Another way of treating solid waste is to burn it in incinerators to reduce the volume. There are three basic types of solid waste incinerators:

(1) mass burning units — individually designed plants which burn unprocessed wastes.



(2) modular units — "off the shelf" units which may mass burn or require that solid wastes are shredded and non-combustible components (glass, metal, etc.) are removed before burning the remainder.

(3) refuse-derived fuel plants — individually designed plants which require pre-separation of wastes so that combustible components can be turned into pellets of fuel.

All three types of incinerators can be designed to generate steam or electrical energy.

The following chart outlines some of the advantages and disadvantages of incinerators.

Incinerators

Advantages	Disadvantages
— reduces volume by 70%	— high cost
— may be able to provide heat for buildings or manufacturing	— need to control air emissions: smoke, ash, odour and other pollutants
— overall landfill requirements reduced by two-thirds or more	— plastics generate corrosive gas which can damage equipment
	— requires skilled and conscientious operators
	— minor conflicts with recycling can result
	— can only process combustible material

(c) Materials Recovery

An example of materials recovery is salvage. Each year, about 65,000 automobiles are scrapped in B.C. A reasonably high percentage of these cars are picked up by salvagers who recover the reusable parts as well as the scrap metal.

Old truck and car tires can be reused to produce new tires, adhesives, wire coverings, rubber matting, conveyor belts, carpet padding and other products. In addition, old tires can be ground up, mixed with asphalt and used to build roads, sports surfaces and airport runways.

Major appliances such as stoves, refrigerators and washing machines are made primarily of metal and therefore represent a recoverable resource. A study conducted in 1980 indicates about 40% of the material used in these appliances is being recovered.

2. LIQUID WASTE MANAGEMENT

Domestic sewage can be treated to reduce its undesirable qualities before it is released into the environment. The three basic levels of sewage treatment are *primary*, *secondary* and *tertiary*.

Primary treatment removes about 50 to 60% of the suspended solids, a portion of the heavy metals and reduces the *biological oxygen demand* or *B.O.D* by 25 to 40%. (B.O.D. is the reduction in the amount of oxygen available caused by the decaying of organic matter.) The resulting sludge is taken to a landfill or "digested" on-site in another treatment process. The remaining liquids may receive further levels of treatment or be discharged directly to land or water, depending on the conditions of the receiving environment.

Secondary treatment removes from 85 to 95% of the B.O.D. and suspended solids. The sewage is biologically decomposed into its less harmful components. Secondary treatment is far more effective than primary treatment but the resulting water is still far from pure. Neither primary nor secondary treatment, however, effectively removes nitrogen or phosphorus which act as fertilizers and, under certain conditions, promote eutrophication of lakes and streams.

Tertiary treatment removes specific impurities through further biological, physical or chemical treatment. It can be a complex and expensive process which must be custom-designed so effluents match the conditions of the receiving environment.

Although most B.C. communities have primary and secondary facilities, the major discharges in the Lower Mainland receive only primary treatment.

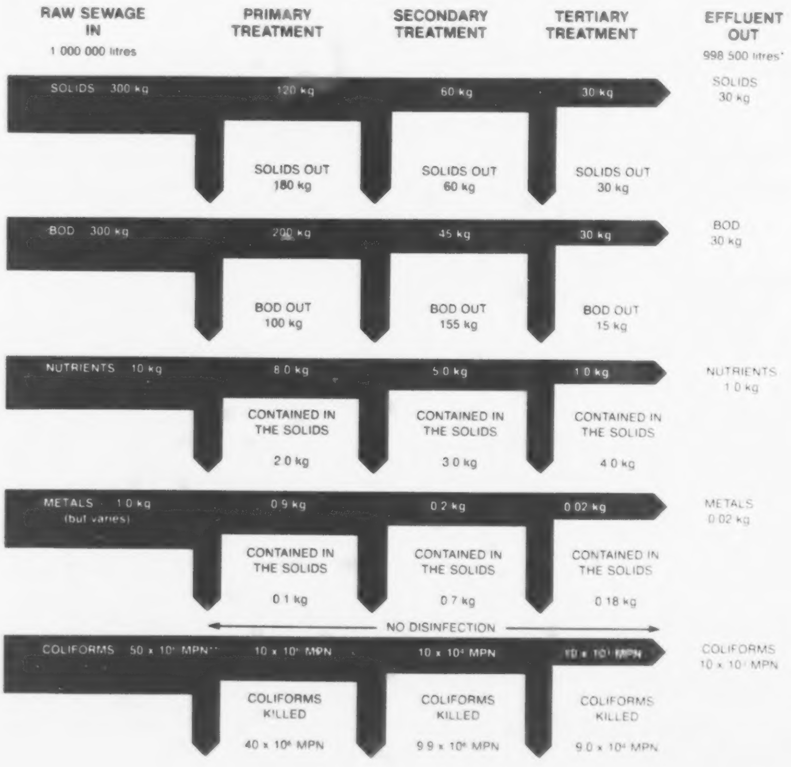
Industrial effluent treatment follows a similar pattern to municipal domestic sewage treatment. The largest source of industrial liquid wastes in British Columbia is pulp and paper mills. Most Interior pulp mills have primary and secondary treatment facilities. Although most coastal mills have some form of primary treatment, few have secondary treatment facilities.

Under existing law anyone discharging wastes into the environment must be authorized by the provincial government.

The law permits a municipality to submit a comprehensive waste management plan to the B.C. Ministry of Environment. If the plan is approved, the municipality does not have to apply for a permit when it discharges its solid wastes or sewage effluent.

LIQUID WASTE MANAGEMENT
TYPICAL SEWAGE TREATMENT EFFICIENCY DIAGRAM

(NUMBERS APPROXIMATE)



*The amount of effluent discharged from this "typical plant" is approximate because the solids are removed as a wet sludge.

**MPN — Most Probable Number (of Coliform bacteria)

3. GASEOUS WASTE MANAGEMENT

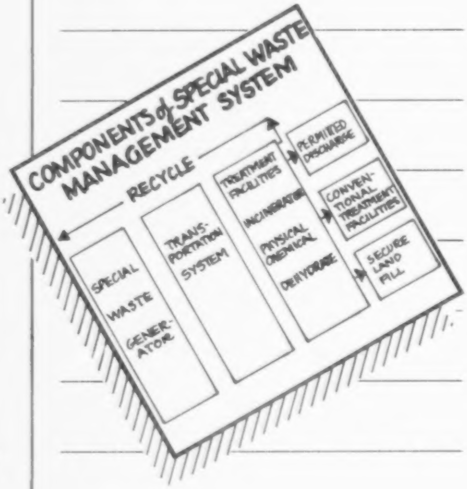
Gaseous wastes produced by metal smelters, pulp mills and the petrochemical industry are released into the air primarily through smokestacks. The smokestack is the basic gaseous waste management tool. The height of the stack is an important factor. A higher stack will disperse the emissions over a larger area than a shorter stack, ensuring the emissions are less concentrated when they return to ground level.

Devices such as *scrubbers*, *bag filters*, *electrostatic precipitators*, *cyclone collectors*, *catalytic converters* and *afterburners* can be used to reduce the levels of particulate and gaseous emissions. In most cases in B.C., gaseous wastes produced by industry enter the environment only after they have passed through at least one of these devices.

The other major type of gaseous wastes are vehicle emissions. Because of their dispersed nature, they are more difficult to manage. But devices such as *catalytic converters*, which require the use of unleaded fuels, have reduced the amount of environmentally destructive gaseous emissions from cars. (Catalytic converters use heat and chemical catalysts to change the molecular structure of the hydrocarbons and carbon monoxide in engine exhaust into water and carbon.) In addition, because newer cars utilize more efficient combustion technologies, they use gasoline more efficiently and produce fewer emissions.

4. SPECIAL WASTE MANAGEMENT

Special wastes need special care. Because they are potentially hazardous to human health and the environment, they require special management techniques to reduce or eliminate the hazard. Acids, bases, solvents, pesticides and heavy metals are some of the wastes which are often defined as special wastes. They may be corrosive, ignitable, carcinogenic, mutagenic, teratogenic, bioaccumulative, reactive, toxic or infectious. Radioactive wastes, which also pose serious problems, are not formally defined as special wastes, and presently come under the jurisdiction of the Federal government and the B.C. Ministry of Health.



A number of scenarios presently occur regarding the fate of special wastes now being generated in British Columbia. Most of the special wastes are already being properly managed. Some are shipped to disposal facilities in Oregon and Idaho, while others are recycled, treated or stored awaiting the development of appropriate facilities in B.C. Waste oils, which comprise the largest proportion of special wastes in the province, for example, are routinely recycled or biologically treated through landfarming operations in the Lower Mainland.

Not all of British Columbia's special wastes, however, are being managed by the best available methods. While these circumstances are difficult to quantify, some special wastes are finding their ways into sewer systems and sanitary landfills, some are accidentally spilled, and some, worst of all, are deliberately discharged at inappropriate sites.

The most effective method of managing special wastes would be to avoid producing them in the first place. That, however, is not usually possible or practical. Nevertheless, the approaches for handling the special wastes that are produced can be listed as follows:

(1) reuse or recycle as much special waste as possible, for example by participating in a waste exchange program so the special wastes can be used by other industries.

(2) treat the wastes at the site of generation in order to avoid the risk of transportation of hazardous substances.

(3) ship the wastes off-site to special waste management facilities for proper treatment, destruction or disposal.

Many special wastes can be treated to reduce their hazards. Acids may be neutralized by bases, often producing a heavy metal sludge which is usually easier and safer to manage. Solvents and many organic compounds may be incinerated, and their heat value recovered for use in other processes. The management of residuals from the treatment and destruction of special wastes requires special attention. A preferred method is to solidify or encapsulate these wastes. They can then be placed in a secure landfill which is carefully designed and constructed to contain the wastes and to prevent entry of precipitation, ground and surface waters.

Proper transportation of special wastes is also important. While it is difficult to guarantee safe transportation of these wastes, measures can be taken to ensure that shipments are tracked from "cradle-to-grave" and that wastes are transported in sound containers.

Many special wastes can be treated or neutralized in a number of ways. The harmless residuals can then be discharged into sewers or disposed of at sanitary landfill sites. A preferred method of managing hazardous residuals is to solidify the wastes and place them in a *secure landfill*. The techniques for solidifying special wastes include:

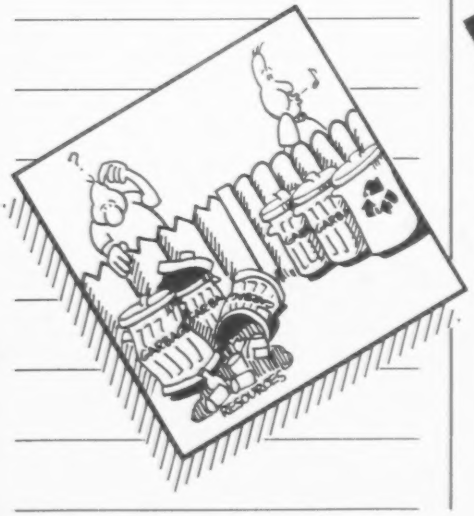
- adding cement-based materials which chemically and physically bind the special wastes together
- surrounding the wastes in melted plastics which then harden and securely encase the wastes
- using a chemical catalyst to turn the special wastes into solids.

At a secure landfill, the "solidified" special wastes must be kept isolated from the environment. The options for secure landfill sites include:

- drilling storage areas in a geologically-stable area such as in the bedrock of the Canadian Shield
- disposing wastes in abandoned mine shafts with relatively little ground water movement.

These underground storage sites could be made even more secure by lining them with an *impermeable* membrane.

Because radioactive materials remain potentially harmful for thousands of years, these types of wastes present very special problems. Scientists continue to search for ways of ensuring that the methods used to manage these wastes will be effective for as long as the wastes are hazardous.



IMPROVED WASTE MANAGEMENT PRACTICES

Each year, large volumes of domestic and industrial wastes are produced which must be collected and disposed of. Recent studies have indicated that as much as one-third of what are currently considered to be *wastes* are actually *resources* which could be recovered and reused. If we were to recover the resource component, we could reduce our waste disposal problems as well as the negative effects which waste disposal has on the environment.

The three underlying principles of improved waste management are *reduce*, *reuse* and *recycle*.

1. Reduce

Reduce the amount of waste wherever possible. Some ways to reduce waste are:

- be aware of alternatives to products in disposable packaging (e.g. non-returnable bottles) and disposable products (e.g. disposable razors).
- use energy (home, car, work) more wisely.
- reduce the amount of wastes generated unnecessarily at home, school and work.
- reduce paper consumption.
- consider whether products are overpackaged.
- reduce the amount of wastes generated in manufacturing.
- avoid making the waste in the first place.

2. Reuse

Reuse items whenever possible. Some examples are:

- use old jars to sort and store such things as nails and screws.
- repair broken items rather than buy new ones.
- use re-fillable beverage containers and return them when empty.
- donate old clothes and furniture to charities.
- reuse building materials such as lumber, bricks, flooring, trim and doors recovered from demolition sites.
- reuse paper which is blank on one side.
- reuse industrial chemicals and special wastes.
- reuse waste heat in industry.

3. Recycle

Recycle materials when possible. Some examples include:

- recycle paper products such as newspapers, boxes and cardboard.
- recycle non-returnable bottles and jars.
- recycle tin, steel and aluminum cans.
- compost food and garden wastes.
- recycle waste water used in industry.
- recycle chemicals which are released into the environment in liquid effluents and gaseous emissions.
- recycle plastics, rubbers and textiles.
- recycle used motor oil and lubricants.

Paper, organics (food and plant wastes), glass and metals account for about 50% of the solid wastes generated in the domestic waste stream. All four of these materials can be recycled. It is not possible, however, to recycle 100% of all these wastes. Coated papers (e.g. milk cartons) and paper with plastic attached (e.g. blister packs) and other materials cannot be recycled. These materials must be separated from the recyclables and disposed of in other ways.

Recyclables Chart

Type	Resource	Recycled into
Solid	paper	newsprint, paper, cardboard, packaging, home insulation
	glass	glass
	metal cans, scrap metal	other metal products
	rubber products	adhesives, rubber backing, retreated tires, asphalt, sports surfaces
	organic food & garden wastes	compost
	some plastics	other plastics
	food processing & farm wastes	animal feeds, fertilizers
	wood wastes	process heat
	textiles	new fabrics, flooring, roofing
Liquid & Special	oils, lubricants	oils, lubricants
	industrial chemicals and heavy metals	reprocessed and reused by other industries
	mine tailings	water is recycled
	pulping liquors	chemicals are recovered

One of the major barriers to recycling is that household wastes are mixed together. The simplest solution is to make a practice of automatically separating recyclable items from other wastes in our homes. The recyclable and reusable items could then be handled separately from the residuals.

At present, about 7% of the domestic waste stream in the Lower Mainland of B.C. is recycled. If there was curb-side pick-up of recyclables already separated in the home, it is estimated that 11% of the current volume of domestic solid wastes could be recycled.

On an individual basis, many households could reduce the materials and/or resources they throw away by up to 50%. A 20 to 30% reduction is possible if all recyclable paper products are separated from the rest of the "garbage". Household "garbage" could be reduced by another 5 to 10% by recycling glass and metals. If garden and food wastes are composted, a further reduction is possible.

Improved waste management has a number of benefits:

(1) The recovery of resources helps keep both the amount and total loading of wastes within the carrying capacity of the environment, helping to improve the environment.

(2) The demand on raw resources which would otherwise be needed to manufacture new products is decreased (e.g. each tonne of recycled paper saves the equivalent of 17 trees).

(3) The use of recycled materials in manufacturing results in fewer air emissions and effluents.

(4) The amount of solid wastes which must be disposed of in landfills is reduced, helping save energy and extend the life span of landfill sites.

(5) The use of recycled materials in the manufacture of new products helps reduce the amount of energy required to make the same product from new resources.

(6) The reduction of wastes in the home saves money.

Module Three Terms

afterburners
bag filters
biological oxygen demand
carrying capacity
catalytic convertor
cyclone collector
electrostatic precipitator
impermeable
incinerator
landfill
primary treatment
recycle
reduce
reuse
salvage
scrubbers
secondary treatment
secure landfill
tertiary treatment
total loading
waste

NOTES

MODULE 3.10

MODULE #3 — QUESTIONS, PROJECTS AND ACTIVITIES

1. Define the following terms:
   - (a) total loading
   - (b) sanitary landfill
   - (c) catalytic convertor
   - (d) biological oxygen demand
2. Investigate the solid waste generated in your area by answering the following questions:
   - (a) Is home garbage collection mandatory? Who collects the garbage? Who pays for the garbage collection?
   - (b) Businesses and institutions have different types of garbage collection services. Research the ways in which a business or institution (school, hospital, etc.) disposes of garbage.
   - (c) What are the quantities and types of material discarded?
   - (d) How are waste materials finally disposed of and where?
   - (e) What recycling, if any, occurs in your community?
   - (f) What types and amounts of materials are recycled or reused in your community?
3. Set up a "mini-landfill" in your class and predict what will happen to each piece of "waste" placed in it.
   - (a) Obtain 3 or 4 tall drinking glasses or clear plastic containers.
   - (b) Place 5 cm to 7.5 cm of moist, loamy soil in each container.
   - (c) Collect a variety of small pieces .5 cm to .8 cm of common household waste products such as vegetable peelings, apple cores, stale bread, paper, plastic, metal, glass, etc.
   - (d) Bury the pieces at different depths against the sides of the containers, so each piece is visible.
   - (e) Cover each container tightly with aluminum foil.
   - (f) Every second day, observe and record what is happening to the waste products in the "landfill". Compare the results with your prediction.
   - (g) As an extension activity, construct and operate a composting experiment, using either school or home waste products.
4. Three ways of improving waste management and optimizing resource use are to *reduce*, *reuse* and *recycle*. Investigate and report at least two examples of how local industries or institutions reduce, reuse or recycle their wastes.
5. Selecting the location for a landfill site can be a difficult task.
   - (a) Identify the factors that determine where a sanitary landfill site is located.
   - (b) Contact local government offices to determine how the location for a landfill site in your area was chosen.
   - (c) Was the site selection process controversial? Why?
6. **The following is a teacher directed activity** — If there is a waste disposal site or waste treatment operation in your area, call the administration office and inquire about a tour. If a tour isn't possible try to arrange for a speaker to come to class. Before the tour or lecture, it is important to:
   - (a) Discuss all phases of the waste disposal and treatment process, particularly as it relates to the local area.
   - (b) Arrange to have the tour or speaker follow the disposal/treatment in sequence.
   - (c) Assign each student, or groups of students, specific tasks to be completed during, or immediately following, the tour or lecture.
   - (d) In the case of a tour, stress the importance of safety at all times.
7. Industry produces a number of special wastes which may be toxic and dangerous to the environment. These special wastes need special

treatment. A number of suggestions have been made for future waste disposal methods. The ideas range from burying special wastes deep in the Canadian Shield to sending special wastes to the moon. Investigate and report on at least two proposed methods for disposing of special wastes.

8. If *you* had the ability to change any aspect of the current way in which solid wastes are managed in your community, what would you do and why?
9. Develop an improved waste management strategy or plan for an institution or business. Describe how the system works and how it could benefit the institution or business and the community.

NOTES

MODULE #4

WASTES COSTS

BC MINISTRY OF ENVIRONMENT

Canadian Cataloguing in Publication Data
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1. Refuse and refuse disposal - British Columbia.
I. British Columbia. Ministry of Environment.

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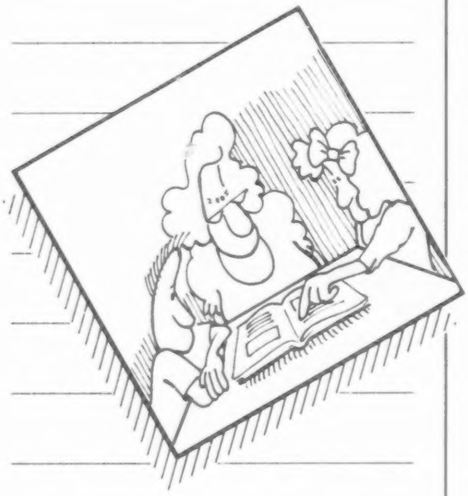
TEACHER'S PAGE



MODULE #4

WASTES COSTS

SYNOPSIS

This module explores the tangible and intangible costs of current waste management systems and provides some examples of how "wastes" can be used as "resources".

PURPOSE

To understand the costs associated with the production, treatment and disposal of wastes.

LEARNING OUTCOMES

Students will be able to:

- (a) identify and illustrate some of the direct environmental, economic and social costs of wastes
- (b) identify and illustrate some of the indirect (hidden) environmental, economic and social costs of wastes
- (c) identify and compare some of the short, medium and long term effects of the production and disposal of wastes

CONTENT OUTLINE

1. Tangible Costs of Current Waste Disposal Systems:
   - (a) waste collection and disposal costs
   - (b) indirect costs of wastes, pollution
   - (c) indirect costs of industrial wastes
2. Intangible Costs of Current Waste Disposal Systems:
   - (a) health impacts on
   - (b) environmental impacts
   - (c) resource depletion

Suggested Use	Time Required
Science 10 Social Studies 10 Consumer Education Environmental Education Gifted Students or Directed Studies	1–2 hours

Module #4 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports, and publications dealing with various aspects of resource recovery and use such as "Financial Analysis for Recycling Projects", *BioCycle: Journal of Waste Recycling*, September-October, 1983.
2. The other teaching aids in the Resources and Wastes package including; #1 "Resources and Wastes" #2 "Wastes Streams", #3 "Wastes Management", #5 "Resource Recovery", #6 "Roles, Responsibilities and Legislation", #7 "Consumer Choices" and #8 "Getting Involved".

MODULE #4 — REFERENCES AND RESOURCES

Economics of the Environment — Selected Readings, Norton and Company, New York, New York, 1982

Environmental Education Kit — Recycling and Conservation, Environment Canada, Ottawa, Ontario, 1984

Facts for Environmental Studies, Ontario Ministry of Environmnet, Toronto, Ontario

Guidelines For Recovering Used Motor Oil from Do-It-Youself Oil Changes, Waste Management Advisory Board, Toronto, Ontario and Environment Canada, Ottawa, Ontario, 1981

"Hazardous Wastes — Storing Up Trouble", Boraiko, A., National Geographic, Washington, D.C., March, 1985

It Stacks Up (Air Pollution Explained), New York Department of Environmental Conservation, Albany, New York

Managing the Waste Problem, U.S. Environmental Protection Agency, Washington, D.C., 1981

Materials Recycling: The Virtue of Necessity, Chandler, W., The Worldwatch Institute, Washington, D.C., 1983

"Mining the Urban Ore", Knapp, D., Sierra Magazine, May/June, 1982

Net Energy Savings from Solid Waste Management Options (A Summary), Love, P., Environment Canada, Ottawa, Ontario, 1976

Paper Save — Recovery of High Grade Waste Paper . . . A Pilot Study, B.C. Ministry of Environment, Victoria, B.C., 1980

Pollution Control Objectives (a series of pamhlets on different B.C. industries), B.C. Ministry of Environment, Victoria, B.C.

Profit From Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling, Pollution Probe Foundation, Toronto, Ontario, 1982

Recovery of Resources From Solid Wastes in B.C., B.C. Ministry of Environment, Victoria, B.C., 1981

Repairs, Reuse, Recycling — First Steps Toward A Sustainable Society, Worldwatch Institute, Washington, D.C., 1978

The Conserver Solution, Solomon, L., Doubleday Canada, Toronto, Ontario, 1978

The Lower Mainland Refuse Project, Concepts Report, Greater Vancouver Regional District, Vancouver, B.C., 1984

UPDATES

HOW AND WHAT TO RECYCLE

SOURCE SEPARATION — means setting aside recyclable materials like paper, cardboard, glass and metals from wastes in your household or business. Successful recycling depends on materials not being mixed with garbage or other types of recyclables.
FOR MORE INFORMATION CALL Ministry of Environment 387-4321.

Newspapers

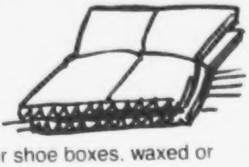
Pile in 12" bundles. Secure with twine. No magazines or phone books.

Brown Grocery Bags

No bags of other colors. Printing on bag OK. Bag or box.

Magazines

Bundle or box.



Corrugated Cardboard boxes

Flatten, bundle, tie with twine. No cereal or shoe boxes, waxed or plastic-coated cardboard. Egg cartons OK.

Office Waste Paper

Includes white or colored ledger, computer paper and cards. Box or bag.

Glass

Rinse, remove lids, caps or neck rings. Paper labels OK. Color sort — green, brown, flint. Bag or box. No window glass, pyrex or drinking glass.

Bottles

Most pop and beer bottles returned for refunds. Depots which take them are listed in the Yellow Pages under *Bottles — Used*, or return to retail place of purchase.

Plastics

Recycling plastic waste is difficult especially on a small scale. Since no market exists it is best not to accumulate more plastic than you can *reuse* yourself. Plastic pop bottles can be returned for refund.

Tin Cans

Rinse, remove labels. Remove ends and put in with cans, flatten. Box or bag cans. No lids or bottle caps.

Aluminum

Clean and flatten, all foil, food and non-refundable beverage containers. No foil with paper adhering. Also recycle pots, pans, lawnchair frames, and kitchen utensils.

Other Metals

Household scrap which can be sold for recycling include household appliances, pipe, sheet metal, machinery parts, lead batteries and copper. A list of scrap metal dealers will be found in the Yellow Pages under *Scrap Metal*.

Used Motor Oil

Place in unbreakable, closed containers. Return to an **Oil Save** Depot.

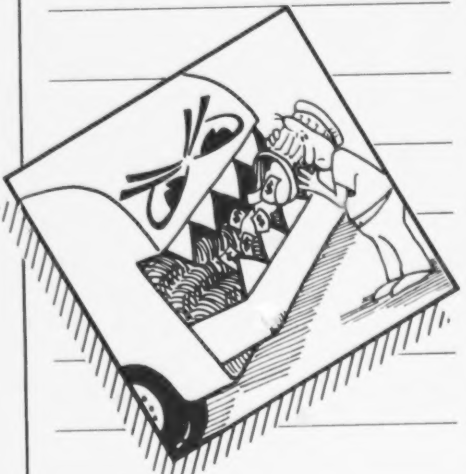
Food and Garden Waste

Food and garden wastes make up one-third of household waste. Composting is a means of processing these wastes into an enriching soil conditioner for your garden while diverting a significant amount of material from your community's solid waste stream. Information on how to compost is available from Waste Management Branch, Ministry of Environment or Horticulture Branch, Ministry of Agriculture.

WASTES COSTS!

Each year, $100 million is spent to collect, transport, treat and dispose of the wastes produced in British Columbia. The production of wastes also results in "hidden" costs, such as damage to human health or the environment, which have other impacts in addition to their monetary cost.

In one way or another, society pays for its wastes. The costs may be *tangible* or they may be *intangible*.



TANGIBLE COSTS

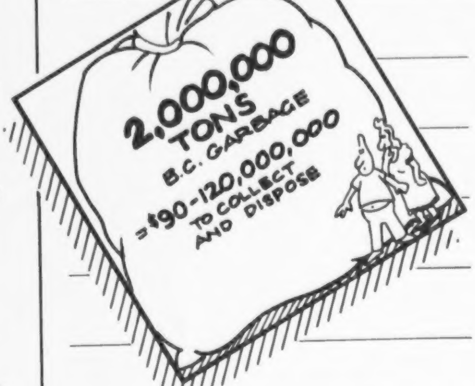
Tangible costs are measurable, definable impacts to which a dollar value can be attached. Tangible costs can be incurred *directly* or *indirectly*. An industry incurs a direct cost, for example, when it installs a waste treatment system. The consumer incurs an indirect cost when he or she buys the product manufactured by that industry — the cost of waste treatment is built into the price the consumer pays for the product.

As a general rule, individuals pay relatively few direct costs relating to waste. Individuals do not pay to have each can of trash taken to a landfill site and they don't pay directly to have streets cleaned, litter removed or waste containers in parks emptied. About the only direct cost to consumers is the purchase of garbage cans and the increased price of items such as cars with mandatory pollution control equipment.

Most of the costs incurred by individuals are indirect. When a consumer buys a product, he or she pays for all activities associated with providing that product. These include:

- design and development
- production costs including labour, energy, interest on loans, materials, facilities and administration.
- marketing, advertising, packaging, distribution and transportation.
- waste control, treatment and disposal
- taxes and profit

Part of the cost to the consumer, therefore, relates to waste treatment and disposal.

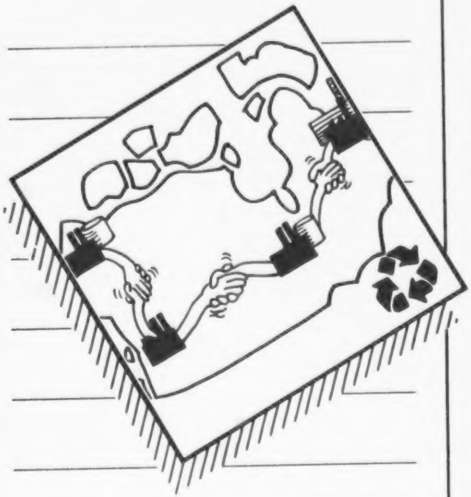


For the householder, the most obvious cost associated with waste disposal is tied to the collection and transportation of domestic garbage. Householders pay for this service indirectly through their municipal taxes or directly to a collection company. The cost of waste disposal in B.C. municipalities varies widely depending upon the size of the community, distance to the landfill site and the level of service provided. The estimated annual cost for the collection and disposal of the close to two million tonnes of municipal solid waste generated in B.C. is between $45 and $60 per ton (80% for collection and 20% for disposal). There are also other costs associated with landfills. The land has an *opportunity cost*, which is the value the land would have if it was used for something other than a landfill site. If the land was used for housing, industry or parks instead, it could be worth more than if it is used for garbage disposal.

There are other indirect waste-related costs borne by taxpayers. In New York City, for example, it is estimated that air pollution results in an annual indirect cost of about $200 per person for such things as extra painting, laundry, washing and cleaning. With about 17 million people living in the New York and the northeastern New Jersey area, the resulting cost is about $340 million a year. In addition, photochemical smog reduces automobile tire life by about 10%. This increases the need for tires which means more energy and resources must be used. In turn, this produces more pollution and the need for more pollution control.

While solid wastes produced in our homes, apartments, institutions and commercial establishments are picked up and disposed of each week, many industries must manage some of their own wastes. A sawmill, for example, cannot put 100 tonnes of wood waste in a container and have it hauled away without paying directly for that service. Consequently, many forestry companies have developed ways to use their wood wastes to produce heat and generate electricity. They are able to use a "waste" from one process as a "resource" in another, turning a *liability* into an *asset*.

Sawmills generate wood waste called *hog fuel* which is burned to produce heat. The heat is then used to make steam, dry lumber or generate electricity. When both heat and electricity are generated and used, the process is known as *cogeneration*. At present, the B.C. forest industry uses hog fuel to provide about 56% of its energy. This is equivalent to approximately 1.5 million cubic metres (9 million barrels) of oil or 22% of all of the energy used in B.C. Some sawmills are not able to use the hog fuel so it is disposed of in *beehive* burners or taken to landfill sites.



Another example of turning a waste into a resource is provided by the manufacturers of metal products. They sell their waste metals to scrap dealers who resell them to companies which can use scrap metals in the production of new metals.

A small but increasing number of industries participate in the *Canadian Waste Materials Exchange* (CWME) program which is sponsored by the federal and some provincial governments, including B.C. Participating companies contact CWME and either register a waste which they can supply, or apply for a waste which they can use. CWME then acts as a clearing house, publishing lists of the wastes available, the wastes that are wanted and the names of consultants with expertise in waste management. A company then contacts CWME to get the name of a business that can supply the wastes it needs, or the name of a company that wants the waste it produces. From that point, CWME drops out of the picture and the two parties deal directly with each other.

In 1981, an estimated 170 000 tonnes of wastes valued at approximately $5.3 million were exchanged as a result of the CWME program. Although a relatively small number of Canadian businesses currently participate in CWME, it is expected that participation rates will increase and the amount of wastes exchanged will rise significantly in the years ahead.

While some wastes can be exchanged, most wastes must be handled or treated by the manufacturer on-site, disposed of on-site, or hauled away to an appropriate landfill. Some manufacturers must pay directly for their waste treatment, transportation or disposal. The increasing cost of waste treatment motivates industry to find more cost-effective methods of waste management. In many cases, the most cost-effective option is to reuse or recycle the wastes so they can be an asset instead of a liability. By reducing waste management costs, industries can lower the price of their products, gain a competitive edge and increase profits.

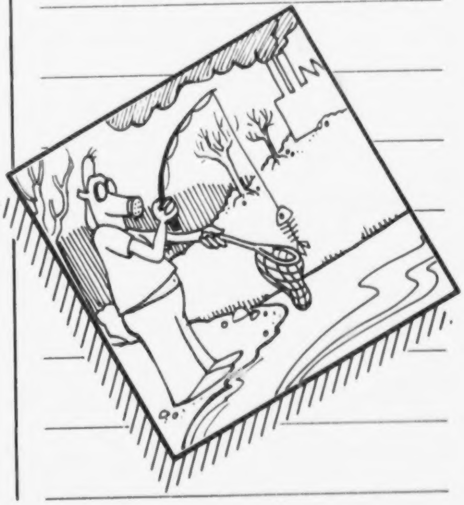
There are instances, however, where the need to make a profit can hinder the implementation of improved industrial waste management practices. The treatment of many chemical and organic wastes can result in additional costs which a company may not want to incur. As a result, the company may continue to generate more waste than necessary.

Governments have established requirements controlling the quantity and quality of discharges. Industries are expected to install waste control or treatment systems to ensure the requirements are met; they then build the cost of the equipment into the price of the products. Consumers eventually pay these costs when they purchase the products.

Despite these requirements and regulations, various wastes continue to affect the environment in many ways. The following chart lists potential impacts of the major types of air contaminants. The degree of impact depends on the level of concentration of the contaminant at a given place and time.

POTENTIAL IMPACTS OF THE MAJOR TYPES OF AIR CONTAMINANTS

Waste Product	Source	Health Impacts	Other Impacts
Particulates	— industry — incinerators — burning fossil fuels — automobiles — furnaces	— disrupts lungs normal self-cleaning	— haze — reduces sunlight — can damage or corrode buildings — soils clothes, buildings
Nitrogen	— automobiles — chemical plants — power plants — refineries	— respiratory infections — eye, nose, throat irritation — can damage lung tissue — can contribute to emphysema	— one cause of acid rain — corrosion of metal — deterioration of rubber and fabrics — can damage vegetation — causes smog — dangerous to animals
Photochemical Smog (Ozone)	— secondary reaction — autos — fossil fuel burning	— eye, nose, throat irritation — lung infections — difficult breathing	— toxic to plants — weakens rubber and textiles
Sulphur Dioxide	— burning fossil fuels — industrial sources	— impairs breathing — eye, throat, lung irritation	— one cause of acid rain — corrodes and deteriorates iron, steel, nickel and aluminum — weakens building materials — deteriorates fibres — corrodes concrete
Carbon Monoxide	— automobiles (about 90% of total) — burning fossil fuels	— reduce blood's ability to absorb oxygen — can cause heart and brain damage — dizziness, fatigue, head-ache, etc. — can aggravate heart disease	
Hydrocarbons	— automobiles — industry	— produce smog when combined with nitrogen oxides + sunlight	— have produced cancer in animals — plant damage



INTANGIBLE COSTS

Intangible costs are those impacts to which it is difficult or impossible to attach a specific dollar value. The following are some examples of intangible costs associated with wastes:

- *loss of health* — people living close to a constant extreme source of air pollution can develop emphysema, bronchitis, lung cancer or other respiratory ailments.

- *loss of environmental quality* — an improperly maintained hazardous waste site can affect an entire area and cause immeasurable damage. A classic example occurred in 1978 when the hazardous chemicals at Love Canal in Niagara Falls, New York, disrupted the lives of hundreds of people.
- *loss of a resource* — if a local river, lake or estuary becomes contaminated with wastes, the water in the area may become unfit for humans, fish and other aquatic life.

EXAMPLES OF COSTS TO CONSUMERS OF DISCARDING WASTES

TANGIBLES		INTANGIBLES
Direct	Indirect	
cost of household waste management — garbage cans/bags	cost of garbage collection and disposal paid through taxes	loss of health or human life
cost of pollution equipment control in cars	cost of packaging is built into price of product	long term health effects of pollution: heavy metals, air and water pollution
	cost of industrial waste management is built into price of products	loss of clean air or water
	costs of energy production	long term environmental effects of pollution: lead, acid rain, photo-chemical smog, etc.
	opportunity value of land used for landfill sites*	loss of aquatic species and wildlife
	decrease in productivity of agricultural or forest land as a result of pollution	destruction of natural ecosystems: lakes, rivers, forests
	costs of clean-up	resource depletion
	increase in health service costs	

* In many cases, landfills can be used beneficially. Recreational facilities and buildings can often be constructed on the site after it is no longer being used as a landfill.

The costs of waste, whether tangible or intangible, have a major impact on our society. While it may be impossible to determine all of the costs involved, the accompanying chart summarizes the primary tangible and intangible costs of wastes. The chart also illustrates that most of the costs of waste management are paid indirectly rather than directly. This may help explain why many people show minimal concern regarding most waste problems.

Module Four Terms

asset
direct cost
indirect cost
intangible cost
liability
opportunity cost
tangible cost

MODULE #4 — QUESTIONS, PROJECTS, AND ACTIVITIES

1. Define the following terms:
   - (a) tangible costs
   - (b) intangible costs
   - (c) direct costs
   - (d) opportunity costs
2. When a consumer buys a product, he or she pays for all activities associated with providing the product. Identify at least four of these costs.
3. The production of wastes results in both *tangible* and *intangible* costs.
   - (a) List 5 tangible costs
   - (b) List 5 intangible costs of waste production (make sure at least one of the examples is a *direct intangible cost*).
   - (c) Give an example of each.
4. Investigate the costs associated with solid wastes generated in your area by collecting information on the following questions:
   - (a) What are the direct costs to the local government for collecting, treating and disposing of solid wastes? List each category of costs separately.
   - (b) How many people are directly employed to manage wastes in your community?
   - (c) What quantities of solid wastes are expected to be generated in your area in the next 10 years to 25 years? Is it more or less than is being generated now? Why?
   - (d) What are the projected costs for managing solid wastes in your area? In British Columbia?
5. Waste exchange programs have been designed to match waste with their potential users. Investigate and report how these programs work and what types of wastes are exchanged. If possible, use an example from a local industry. Two sources of information on waste exchange programs are:

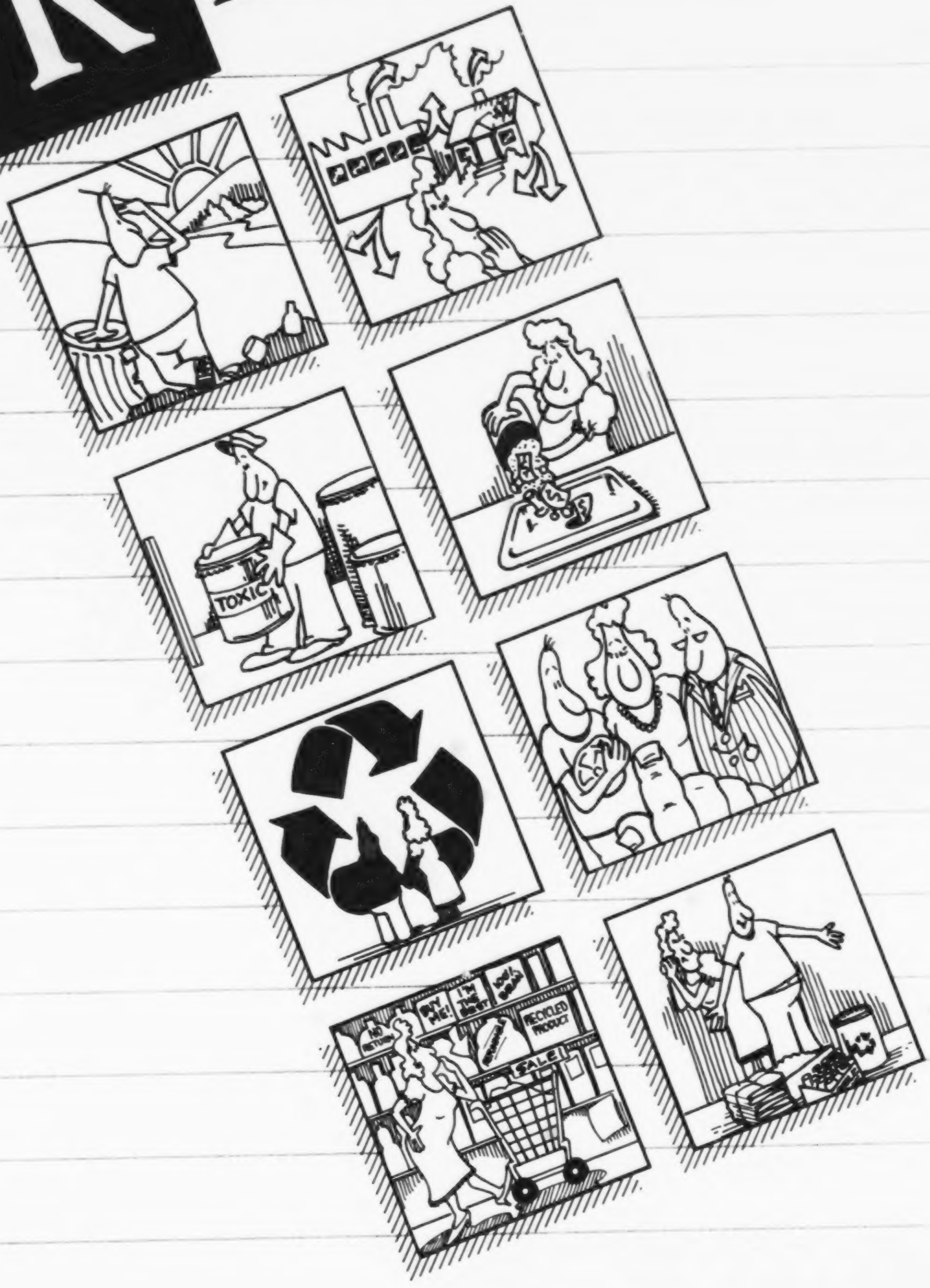
Canadian Waste Materials Exchange
Ontario Research
Sheridan Park Research Community
Mississauga, Ontario
L5K 1B3

Materials Recycling Markets
1262 Don Mills Road
Don Mills, Ontario
M3B 2W7

NOTES

MODULE #5

RESOURCE RECOVERY



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1. Refuse and refuse disposal - British Columbia.
I. British Columbia. Ministry of Environment.

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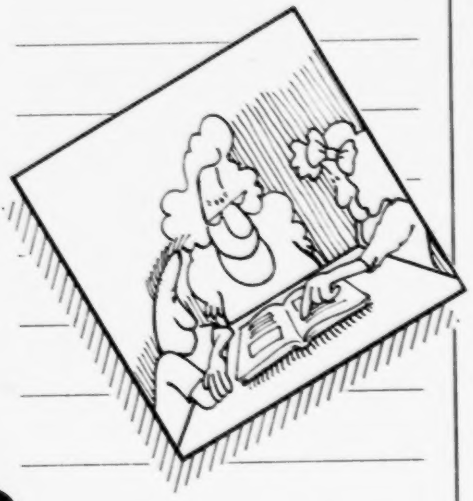
MODULE #5

RESOURCE RECOVERY

SYNOPSIS

The first section of this module explores the benefits and costs of resource recovery. It is followed by a discussion of the barriers to resource recovery. The final section identifies some of the incentives that could be used to encourage increased recovery of resources in our society.



PURPOSE

To understand the costs, benefits, barriers and incentives associated with resource recovery.

LEARNING OUTCOMES

Students will be able to:

- (a) demonstrate some of the potential costs and benefits associated with resource recovery
- (b) explain and debate some of the barriers to resource recovery
- (c) evaluate some of the incentives proposed to evaluate resource recovery
- (d) design a strategy for improved resource recovery for a local business or institution
- (e) describe and evaluate some of the long term implications of improved waste management through increased resource recovery

CONTENT OUTLINE

1. Benefits of Resource Recovery
   - (a) financial benefits
   - (b) resource conservation
   - (c) costs of resource recovery
     - — community recycling costs
     - — industrial resource recovery costs
   - (d) intangible benefits of resource recovery
     - — environmental improvement, health benefits and employment benefits, etc.
2. Barriers to Resource Recovery
   - (a) includes lack of knowledge, reluctance to adopt new technology and lack of investment funds, etc.
   - (b) barriers to municipal recycling projects
3. Incentives for Resource Recovery
   - (a) progressive tax structures, lower freight rates, etc.
   - (b) the "User Pay Solution," one option
4. A Resource Recovery Strategy proposal by the Recycling Council of B.C.

Suggested Use	Time Required
Science 10 Social Studies 10 Consumer Education Environmental Education Earth Science 11 Science and Technology 11	1–2 hours

Module #5 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports, and publications dealing with various aspects of resource recovery and use such as "Hazardous Wastes: Storing Up Trouble", *National Geographic*, March, 1985.
2. The other teaching aids in the Resources and Wastes package including: #1 "Resources and Wastes" #2 "Wastes Streams", #3 "Waste Management", #4 "Wastes Costs", #6 "Roles, Responsibilities and Legislation", #7 "Consumer Choices" and #8 "Getting Involved".

MODULE #5 — REFERENCES AND RESOURCES

"CREDA Project Summary Sheets", Energy, Mines and Resources Canada, Ottawa, Ontario, 1984

Economics of the Environment — Selected Readings, Norton and Company, Norton and Company, New York, New York, 1982

Facts for Environmental Studies, Ontario Ministry of Environmnet, Toronto, Ontario

Guidelines For Recovering Used Motor Oil from Do-It-Youself Oil Changes, Waste Management Advisory Board, Toronto, Ontario and Environment Canada, Ottawa, Ontario, 1981

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The Lower Mainland Refuse Report, Resource Recovery And Recycling, Greater Vancouver Regional District, Vancouver, B.C., 1984

Waste: An Untapped Resource, B.C. Ministry of Environment, Victoria, B.C.

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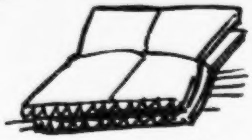

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RESOURCE RECOVERY

Not all waste is waste. It has been estimated that one-third to one-half of what are commonly considered *wastes* are actually *resources* which could be recovered and reused. If the resource components were recovered, then the volume of waste as well as the problems associated with waste disposal could be significantly reduced. As a result, there is growing interest in *resource recovery* as a practical and attractive solution to many of our current and long term waste management problems.

There are *costs* as well as *benefits* associated with resource recovery. Futhermore, there are a number of barriers which must be overcome before increased resource recovery becomes a reality in B.C.

MAJOR MARKETS FOR RECYCLED MATERIALS

Copper	Automotive Components, Electrical Equipment, Household Utensils, Military Ordnance, Power Generators, Tubing, Wire and Cable.
Aluminum	Aircraft, Automobiles and Other Vehicles, Building and Construction, Containers and Packaging, Household Appliances and Cookware.
Iron and Steel	Construction, Motor Vehicles and Parts, Machinery, Railroads and Railroad Equipment, Appliances, Containers.
Lead	Ammunition, Batteries, Cable Sheathing, Gasoline Additives, Printing Type, Solder.
Zinc	Brassmaking, Die-Casts for Automotive and Other Industrial and Consumer Uses, Galvanizing and Coatings, Oxides and Chemicals.
Nickel Stainless Steel	Aerospace, Automobiles and Other Vehicles, Construction, Household Appliances and Cutlery, Machinery, Tools and Instruments, Shipbuilding.
Precious Metals	Decorative Ware, Dental Fittings, Electrical and Electronic, Jewellery, Photographic Materials.
Paper	Boxes, Containers and Paperboard Packaging, Insulation and Construction, Newsprint, Stationery and Books, Towels, Tissues, Napkins.
Textiles	Apparel, Blankets, Carpeting, Batting and Padding, Fine Paper and Currency, Flock and Filler, Roofing and Flooring, Vulcanized Materials, Wiping Cloths.
Rubber	Asphalt Paving, Hosing and Molded Parts, New Tires, Roofing and Siding.

BENEFITS OF RESOURCE RECOVERY

The most direct benefit of resource recovery is the money received when materials which would otherwise be wasted are recovered and sold. The buyers and users of recycled materials are generally large paper, glass and metal processors. Since different processes are needed to manufacture products using recycled, as opposed to new resources, a specialized industry has evolved to remanufacture paper, metal products and glass. While there is likely to be growth in B.C., at present there are only about a half a dozen major industrial facilities which buy and recycle paper and glass. On the other hand, there are numerous scrap metal dealers who are part of a long established industry in this province. Although wide fluctuations in prices are fairly common, the accompanying chart outlines the prices paid for recycled material in 1984.

PRICES PER TONNE* FOR RECYCLABLE MATERIALS (1984)

	$
old newspaper (ONP)	38– 55
old cardboard (OCC)	44– 77
white ledger	76–110
coloured ledger	65– 93
computer paper	132–198
tab cards	143–176
glass—uncontaminated and sorted	60
ferrous metals, including clean, flat cans	33– 66
aluminum	440

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* Many companies which purchase recyclable materials prefer to deal in Imperial tons rather than metric tonnes because much of the recycled material is exported to the U.S.A.

Because recycling can reduce waste volumes and some of the costs associated with collection and disposal, some recycling groups have managed to obtain a *subsidy* from taxpayers in their area in the form of *diversion credits*, grants to recyclers, reduced property and business taxes or rent-free buildings to house the recycling centre. In the case of diversion credits, the authority handling the wastes pays the recycling project an appropriate sum for the recyclable component of "garbage" which is diverted from the waste stream. It has been estimated, for example, that the amount of garbage which municipalities would have to dump in landfill sites could be reduced by 20 to 30% through source reduction, recycling and reuse. The resulting 10 to 20% reduction on collection costs, could amount to a saving of $3 to $7 million per year.

A great deal of energy can be saved if certain products are reused in their original form. The classic example is the refillable beverage bottle. It takes much less energy to wash and refill a bottle than it does to recycle the glass or produce new bottles. Pop bottles are generally reused up to 12 times, while beer bottles can be refilled as many as 40 times.

Energy is also saved by using recycled materials to produce paper, glass or metal goods. The following chart presents a comparison of energy consumption in processing materials from recycled and raw materials.

COMPARISON OF ENERGY CONSUMPTION IN PROCESSING MATERIALS FROM RECYCLED AND RAW MATERIALS

Material	kJ/kg used to process		Savings
	raw	recycled	
Newsprint	26 500	20 470	23%
Glass Containers	18 145	16 750	8%
Steel: 40% scrap	19 300	17 445	10%
100% scrap	19 300	10 235	47%
Copper	60 245	6 745	95%

Source: B.C. Ministry of Environment.

By using recycled materials, the need to harvest, mine or extract new resources is reduced. In addition, energy consumption, waste production and environmental disruptions are reduced. Material which is taken from the waste stream but cannot be utilized or sold, however, is returned to the waste stream via a costly diversion.

The following table presents estimates of the pollution reduction as well as energy, water and material savings which are possible through the use of recycled materials.

ESTIMATE OF POLLUTION REDUCTION AND ENERGY, WATER AND MATERIAL SAVINGS BY USING RECYCLED MATERIALS IN THE PRODUCTION OF NEW GOODS

100% Recycled Materials	Energy Saved	Air Pollution Reduced	Water Pollution Reduced	Source Waste Reduced	Water Saved	Materials Saved
	%	%	%	%	%	%
Paper	23–70	60–73	15–61	39	61	90–100
Glass	8	20	50	80	50	54
Steel	47–75	86	75	97	40	90
Aluminum	97	96	97	100	95	98

Source: B.C. Ministry of Environment.

Many of the resource recovery options have "direct dollar and cents" benefits for industrial and commercial establishments. Photo processing plants, for instance, normally recover silver during the developing process and then sell it to other users. A company in Winnipeg is now recycling 85% of its developing solution, substantially reducing both its monthly chemical bill and its wastes.

The people of the Greater Vancouver Regional District also benefit by recovering resources while treating sewage. Since 1978, the sludge from the Iona Island treatment plant near Vancouver has been dried, sterilized and then used as a fertilizer additive that meets the requirements of the *Fertilizer Act*.

Money and resources can also be saved by simply making more efficient use of a resource. The printing industry, for example, wastes an average of 5% to 8% of the paper it uses. By pinpointing the wasteful operations in their printing operations, a newspaper company in Florida has managed to cut its waste to 2.4%, saving almost $200,000 a year.

Many products made with recycled materials can be produced less expensively. A British Columbia oil company, for instance, collects used motor oil and reprocesses it into a new high quality product. This process is potentially less expensive than refining oil from crude oil.

All of these benefits have their own tangible and intangible *spin-off effects*. Reduced costs could mean increased profits, which could lead to more jobs. Reduced water pollution could boost fish populations, and could benefit recreational and commercial fisheries. Reduced energy use could help to make existing supplies of non-renewable energy resources last longer. Other intangible benefits of resource recovery include:

1. *Resource Conservation* Resource recovery can help conserve resources by reducing the amount of raw materials required to create products.
2. *Environmental Improvement* Resource recovery reduces environmental impacts associated with resource extraction.
3. *Health Benefits* Reducing pollution at the source can decrease health hazards to nearby populations.
4. *Employment Benefits* Reusing resources may help manufacturers to remain competitive and provide more jobs in their communities. Recycling projects can also create employment opportunities for community groups or entrepreneurs.
5. *Conservation Orientation of the Community* Community efforts to save energy can help many communities develop a broader conservation orientation. Several years ago an area-wide effort to save energy in Vernon, B.C. helped get the community involved in an examination of additional ways the city could conserve other resources.

Resource recovery has a wide range of benefits, particularly when all the spin-off effects are considered. The following table provides a brief summary of many of these benefits.

BENEFITS OF RESOURCE RECOVERY

TANGIBLE		INTANGIBLE
Direct	Indirect	
funds from sale of materials	energy savings	pollution reduction environmental improvements
direct cost savings to industry and commerce	reduced resource use	health benefits
	employment opportunities	resource conservation
		community pride and conservation orientation
		community service opportunities

COST OF RESOURCE RECOVERY

There are some costs associated with resource recovery.

Recycling household wastes such as paper, metal and glass means added costs for collecting, transporting, sorting and cleaning the materials. The need for workers to process and handle the materials usually makes up the greatest percentage of these costs. The following table is based on the findings of a study commissioned in 1980 by the B.C. Ministry of Environment regarding the cost of various recycling activities:

Recycling Activity	Cost per Tonne $
processing and handling for recycling centres	26–70
processing and handling for source-separated curbside pickup	17–70
overhead for large communities (i.e., over 60,000 people)	2– 4
overhead for small communities	up to 45
transportation less than 30 km	5–25
transportation more than 30 km	16–25

On average, the costs of recycling household wastes can range from $70 to $100 per tonne. To obtain the *net cost of recycling*, it is necessary to subtract the revenues from the sale of the recycled goods from the collection costs.

The study also investigated the cost of a separated curbside pickup program designed to recycle 92 000 tonnes of paper, glass and metal a year from the 14 major regional centres in B.C. The study estimated the total capital expenditures would be about $2.5 million with annual operating costs of more than $6 million.

There are few other direct costs associated with resource recovery programs and the indirect costs tend to be minor. A family may have to give up a small amount of space to store separated materials and someone may have to drive to a recycling centre every week or so to drop off material. In the case of curbside pick-up programs operated by municipalities, taxpayers must pay the added costs indirectly through their taxes. High participation can help minimize extra costs because of increased revenues from the higher volume of recyclable materials which are collected and sold.

Industries involved in resource recovery projects may bear some costs. Removal of waste products such as chemicals, heavy metals or heat from discharges may require additional expenditures. But resource recovery tends to be a cost-saving activity, rather than a cost-producing one for most industries. A brewery in Saskatchewan, for example, recovers between 25 and 50% of the heat escaping from its smokestacks and reuses it in the brewing process. This has resulted in an estimated annual energy saving of $129,000.

Rexham Corporation, of Greensboro, N.C., installed a Flexo printer which reclaims reuseable solvents from waste inks. This new printer has reduced the company's hazardous waste disposal costs by 76% and decreased its raw material costs by 16%. The initial capital expenditure was $16,000 and the system modification had a payback period of slightly less than a year. In the process, Rexham has reduced the volume of hazardous waste it produces by 74%.

Pioneer Metal Finishing, Inc. installed a sludge concentrator and a total solids removal system to lower the production of hazardous wastes (cyanides). It resulted in an 80% reduction of the amount of hazardous wastes produced and a saving of 43 525 litres of water a day. All the water is reused, except what evaporates. The payback period was three years with an annual saving of $52,000.

In the past, biomass waste from the production of beer at the Miller Brewing Company in St. Louis was hauled to a landfill at an annual cost of $112,000. It is now being sold as a liming material and fertilizer to local farmers at $1.13 per tonne resulting in a potential income of $3,825 per year. There were no operating or capital costs: consequently the payback period was instantaneous. The biomass waste is far cheaper than normal liming materials and provides an additional 1% nitrogen, a valuable fertilizer component.

BARRIERS TO RESOURCE RECOVERY

There are a number of barriers to improved resource recovery which must be overcome. These include:

(1) Lack of knowledge

Perhaps the most common barrier to resource recovery is that the producers of wastes do not know about resource recovery and waste reduction options. Companies which produce large volumes of wastes have a clear incentive to research and develop waste recovery systems because the cost can be justified: they provide a solution to waste disposal problems and recover valuable resources. Small companies, however, may lack technical staff to investigate waste management technology.

Many individuals are also unaware of the problems which may be associated with domestic waste management because once the garbage is taken to the curb on garbage day, it's "out of sight, out of mind." Futhermore, many individuals do not know how to recycle or reuse their wastes.

(2) Reluctance to adopt new technology

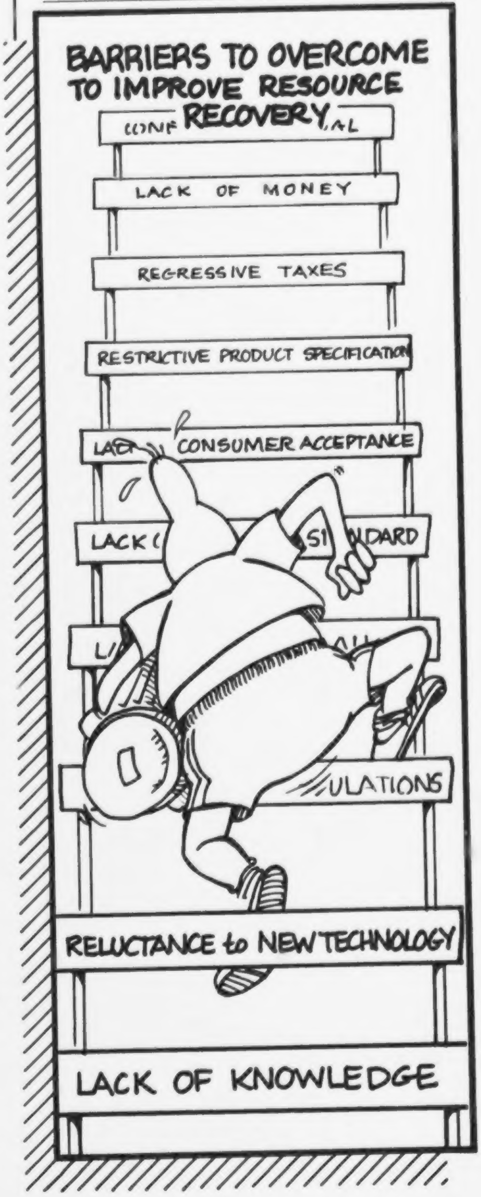
People often like to stick with the traditional, habitual "proven" ways of doing something and are slow to adopt new technology.

(3) Incomplete cost calculations

When people calculate the benefits of a resource recovery project, they frequently neglect to include the indirect and intangible benefits which can come from it. As a result, they may conclude that resource recovery is not financially viable.

(4) Lack of investment funds

A problem facing both large and small companies in poor economic times, even though they may have identified opportunities to reduce *operating* costs for waste management, is that they lack funds to invest in new equipment and processes required.


BARRIERS TO OVERCOME TO IMPROVE RESOURCE RECOVERY
CONF AL
LACK OF MONEY
REGRESSIVE TAXES
RESTRICTIVE PRODUCT SPECIFICATION
LACK CONSUMER ACCEPTANCE
LACK (S NDARD
ULATIONS
RELUCTANCE to NEW TECHNOLOGY
LACK OF KNOWLEDGE

(5) Lack of purity standards of recycled material

Many industries which could use recycled materials are hesitant because they are concerned about the effects which the use of recycled materials may have on the quality of their manufactured products.

(6) Lack of consumer acceptance for products made from recycled material

Many individuals are reluctant to purchase a product which they know is made from recycled stock because they are unfamiliar with the product. Motor oil which has been recycled, for instance, is just as good as "new" motor oil. However, people may want the "new" oil instead of the "used" oil.

(7) Restrictive product specifications

Product specifications frequently call for the use of only new or "virgin" materials.

(8) Regressive taxes

Many industries benefit from tax edicts that encourage the use of raw resources rather than recycled materials because of our resource-based economy.

Municipal recycling projects commonly face the following barriers:

(1) Lack of money

Perhaps the greatest barrier for municipal recycling projects to overcome is the lack of funds needed to finance the "start-up," as well as ongoing *subsidies* or *diversion credits*.

(2) Convenience of garbage disposal

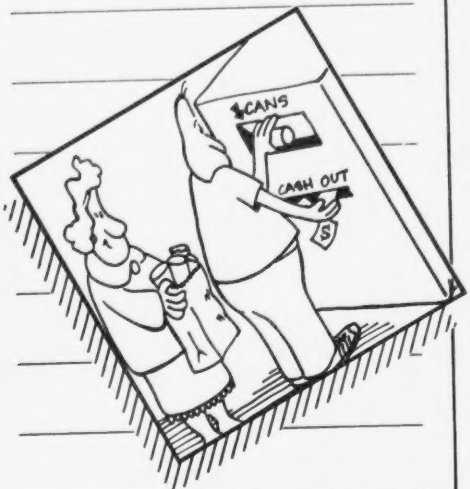
Because it has been so easy and inexpensive for individuals to throw away their wastes, many people are reluctant to make the extra effort required to separate and recycle.

(3) Lack of secure markets

Municipalities with large investments in current waste disposal technology may be reluctant to invest additional funds to start recycling programs without a guaranteed market for the recycled materials.

(4) Limited collection areas

Many communities in B.C. are too small to produce enough recyclable materials to justify the cost of separating and sending them to distant markets in the Vancouver area or out of the country. Even some of the larger Interior centres such as Kamloops or Prince George may have difficulty justifying the costs of transporting recycled materials to market.



INCENTIVES

Various government and non-government agencies, as well as industries have suggested it may be necessary to use a combination of incentives and a major educational campaign in order to encourage greater resource recovery.

Incentives can directly address the barriers that were identified in the previous section. Some of the options available include:

- progressive tax structures
- restructured freight rates
- provision of additional funds to carry on a variety of activities designed to increase resource recovery

- adoption of revised product specifications to accommodate the use of recycled materials
- increased diligence on the part of recyclers to ensure the purity of recycled materials.

Another possible incentive might be the *user pay solution* by which individuals, businesses, institutions and industries pay directly to dispose of their wastes. The rate would be based mainly on the type and amount of wastes involved. Such a system would provide direct incentives for improved waste management in all levels of society.

The User Pay Solution

As a general rule, those who pollute, do not pay the costs or suffer the consequences of their wastes directly. As a result, many of the costs of waste treatment must be borne by the taxpayer.

Because so many of the impacts of waste and pollution do not affect the producer of that waste, there is little incentive for the producer to reduce the amount of waste which is generated. If the producers of wastes had to bear the costs directly, there would be an incentive to reduce the amount and types of waste.

One way of doing this would be to "put a price on waste". Anyone releasing wastes into the environment would be required to make a direct payment to a government agency. Different rates would be charged for different waste products according to their environmental or social impacts. The more harmful the substance, the higher the rate. Extremely dangerous substances would be subject to the highest rates. Such a *pricing system* could also consider geographical location, seasons, wind directions and even days of the week.

By having to pay to dispose of their wastes, industries would have a direct incentive to reduce the volume and toxicity of their discharges.

If householders had to pay a fee for each can or bag of unseparated trash, then there would be a clear incentive to produce less garbage.

In the case of automobile emissions, the price system could have a number of possible advantages. By charging a pollution fee or tax based on the emissions produced by their cars, consumers would have a direct incentive to buy cars which produce lower emissions. This would encourage auto manufacturers to produce cars which generated less pollution.

A major difficulty, however, would be establishing an appropriate pricing structure which would ensure sufficient funds for clean-up and provide adequate compensation where necessary. Another problem would be the establishment of an extensive and costly bureaucracy necessary to implement this *user pay solution*.

Incentives alone may have not be enough. Because about half of the barriers which were identified in the previous section relate to lack of knowledge about resource recovery, an educational program aimed at increasing resource recovery would have to be implemented as well. The best way to implement such a public education program remains unclear. The following strategy was proposed by the Recycling Council of B.C., an association of B.C. recycling businesses and societies.

1. Educate communities and individuals about the full costs of our current waste management system. Once the true costs are understood, the benefits of recycling will likely become self-evident.
2. Facilitate the start-up of recycling efforts with government funds. A schedule of diversion credits which reflect reduced waste collection costs, energy and resource savings, employment benefits, pollution reduction and so on would provide the ongoing subsidy required.
3. Overcome the recycled materials marketing problems faced by small communities by developing regional systems which serve a number of communities. The transportation costs could then be reduced by allowing commercial truckers to lower tariffs for hauling recycled materials from locations where truckers are often unable to find regular loads on return trips to Vancouver and other large metropolitan areas.
4. Enact legislative changes that provide tax and/or other incentives to industry to encourage them to use recycled materials and to reduce waste.

The strategy proposed by the recycling council is just one example of initiatives which could improve resource recovery, in particular, and waste management, in general. Additional strategies can and should be examined at all levels (individual, business, industry, and government) because all sectors have important responsibilities in the effort to develop effective and efficient waste management.

Module Five Terms

benefits
costs
diversion credits
net cost of recycling
pricing system
waste

resources
resource recovery
spin-off effects
subsidy
user pay solution

NOTES

MODULE #5 — QUESTIONS, PROJECTS AND ACTIVITIES

1. Define the following terms:
   (a) resource recovery
   (b) diversion credit
   (c) benefits
   (d) spin-off effects
2. Make a list of waste management techniques currently used, including *resource recovery*, and do the following:
   (a) List various costs and benefits associated with each.
   (b) Select one of the waste management practices currently used and prepare an argument *for* and *against* its continued use.
3. There are a number of barriers to increased resource recovery from wastes.
   (a) Identify what you consider to be the greatest barriers to improved resource recovery.
   (b) Identify and describe the incentives which you think would help improved resource recovery.
   (c) Interview several people involved in resource recovery in your community to determine if they feel more needs to be done to promote resource recovery in your area. List any suggestions they may have for promoting increased resource recovery.
   (d) If you had the ability to eliminate the barriers and provide incentives for improved resouce recovery, what would you do and why? Choose an industry, business, or institution and design a coordinated strategy to improve resource recovery for them.
4. One of the proposed waste management options is the "user pay solution" to waste management problems.
   (a) What is meant by the "user pay solution'?
   (b) How might the adoption of the "user pay solution" affect the production and treatment of wastes?
   (c) Identify 5 different types of household and industrial wastes and how much you think producers should pay for their disposal. Give reasons for your rates.
   (d) What affect, if any, might the "user pay solution" have on the people with different income levels (e.g. high, middle, low)? Explain your answer.
5. Recycling efforts in B.C. receive different types of government subsidies.
   (a) Identify the different types of subsidies received
   (b) Give examples of B.C. communities which are supporting recycling efforts through different subsidies.
   (c) Does your local government subsidize recycling?
   (d) Interview a local government official to determine the reasons for the recycling policy, or lack of it, in your area.
6. Identify an industry or business in your area which treats its wastes and/or recovers the resources from the wastes it produces.
   (a) Determine the reasons why it treats and/or recovers its wastes.
   (b) How much does it cost to treat the wastes?
   (c) Does the business or industry think it receives any benefits from the waste treatment and/or recovery?
7. Describe some of the long term implications of improved waste management practices on such things as health, non-renewable resources, taxes and the environment.

MODULE #6

ROLES, RESPONSIBILITIES AND LEGISLATION

BC

MINISTRY OF
ENVIRONMENT

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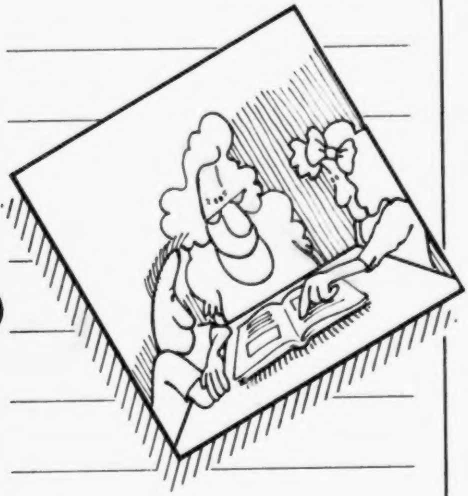
TEACHER'S PAGE

MODULE #6

ROLES, RESPONSIBILITIES AND LEGISLATION



SYNOPSIS

The first section of this module explores the roles and responsibilities of individuals, business, industry and government in terms of waste management. This is followed by a review of the relavent legislation affecting waste management at the federal, provincial and municipal levels.

PURPOSE

To understand the roles and responsibilities of the individual, business, industry and government for waste management and to become aware of specific pieces of federal, provincial and municipal legislation governing waste production and disposal.

LEARNING OUTCOMES

Students will be able to:

(a) identify roles and responsibilities of the following in terms of waste management:
  - — individual
  - — business and industry
  - — government

(b) identify existing federal, provincial and municipal legislation to control wastes

(c) describe and explain how resource recovery of projects in their communities or regions contribute to improved waste management

(d) examine and critique the procedure used in determining the location for a sanitary landfill site in their area

(e) compare and contrast the pollution control objectives for various waste producers

CONTENT OUTLINE

1. Roles of the following:
   (a) individuals
   (b) business and industry
      — current practices
      — project case studies
      — future options
   (c) government/taxpayers
      — program support
      — legislative responsibilities
2. Legislation and Regulations
   (a) federal
   (b) provincial
      — Environmental Management Act
      — Litter Act
      — Special Wastes Regulations
   (c) municipal

Suggested Use	Time Required
Science 10 Social Studies 10 Environmental Education Directed Studies	1–2 hours

Module #6 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports, and publications dealing with various aspects of resource recovery and use such as "Who Will Save the Fraser River?", Mortimore, G., *Readers Digest*, 1985.
2. The other teaching aids in the Resources and Wastes package including; #1 "Resources and Wastes" #2 "Wastes Streams", #3 "Waste Management", #4 "Wastes Costs", #5 "Resource Recovery", #7 "Consumer Choices" and #8 "Getting Involved".

MODULE #6 — REFERENCES AND RESOURCES

Annual Report 1982/83, B.C. Ministry of Environment, Victoria, B.C.

"Hazardous Wastes — Storing Up Trouble", Boraiko, A., National Geographic, Washington, D.C., March, 1985

It Stacks Up (Air Pollution Explained), New York Department of Environmental Conservation, Albany, New York

Materials Recycling: The Virtue of Necessity, Chandler, W., The Worldwatch Institute, Washington, D.C., 1983

"Mining the Urban Ore", Knapp, D., Sierra Magazine, May/June, 1982

Pollution Control Objectives (a series of pamphlets on different B.C. industries), B.C. Ministry of Environment, Victoria, B.C.

Profit From Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling, Pollution Probe Foundation, Toronto, Ontario, 1982

Protecting A Resource: The Fraser River, B.C. Ministry of Environment, Victoria, B.C.

Recovery of Resources From Solid Wastes in B.C., B.C. Ministry of Environment, Victoria, B.C., 1981

Synopsis of the Environment Management Act, B.C. Ministry of Environment, Victoria, B.C., 1981

Synopsis of the Waste Management Act, B.C. Ministry of Environment, Victoria, B.C., 1982

The Lower Mainland Refuse Project, Concepts Report, Greater Vancouver Regional District, Vancouver, B.C., 1984

The Lower Mainland Refuse Report, Resource Recovery And Recycling, Greater Vancouver Regional District, Vancouver, B.C., 1984
"Who Will Save the Fraser River", Mortimore, G., Readers Digest, Westmount, Quebec, March, 1985

UPDATES

HOW AND WHAT TO RECYCLE

SOURCE SEPARATION — means setting aside recyclable materials like paper, cardboard, glass and metals from wastes in your household or business. Successful recycling depends on materials not being mixed with garbage or other types of recyclables. **FOR MORE INFORMATION CALL Ministry of Environment 387-4321.**

Newspapers

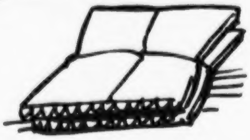
Pile in 12" bundles. Secure with twine. No magazines or phone books.

Brown Grocery Bags

No bags of other colors. Printing on bag OK. Bag or box.

Magazines

Bundle or box.



Corrugated Cardboard boxes

Flatten, bundle, tie with twine. No cereal or shoe boxes, waxed or plastic-coated cardboard. Egg cartons OK.

Office Waste Paper

Includes white or colored ledger, computer paper and cards. Box or bag.

Glass

Rinse, remove lids, caps or neck rings. Paper labels OK. Color sort — green, brown, flint. Bag or box. No window glass, pyrex or drinking glass.

Bottles

Most pop and beer bottles returned for refunds. Depots which take them are listed in the Yellow Pages under *Bottles — Used*, or return to retail place of purchase.

Plastics

Recycling plastic waste is difficult especially on a small scale. Since no market exists it is best not to accumulate more plastic than you can *reuse* yourself. Plastic pop bottles can be returned for refund.

Tin Cans

Rinse, remove labels. Remove ends and put in with cans, flatten. Box or bag cans. No lids or bottle caps.

Aluminum

Clean and flatten, all foil, food and non-refundable beverage containers. No foil with paper adhering. Also recycle pots, pans, lawnchair frames, and kitchen utensils.

Other Metals

Household scrap which can be sold for recycling include household appliances, pipe, sheet metal, machinery parts, lead batteries and copper. A list of scrap metal dealers will be found in the Yellow Pages under *Scrap Metal*.

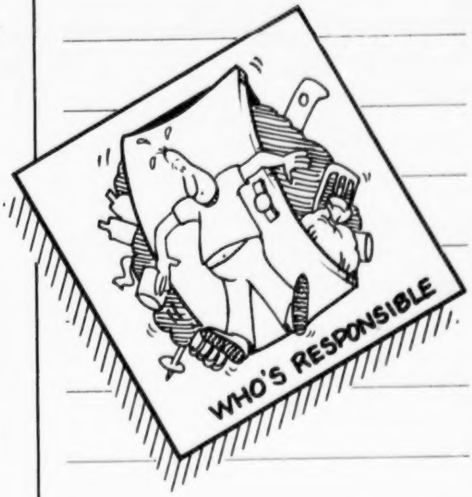
Used Motor Oil

Place in unbreakable, closed containers. Return to an **Oil Save** Depot.

Food and Garden Waste

Food and garden wastes make up one-third of household waste. Composting is a means of processing these wastes into an enriching soil conditioner for your garden while diverting a significant amount of material from your community's solid waste stream. Information on how to compost is available from Waste Management Branch, Ministry of Environment or Horticulture Branch, Ministry of Agriculture.

ROLES, RESPONSIBILITIES AND LEGISLATION



It's been said that garbage is something that everybody wants picked up, but nobody wants put down. The statement is a reflection of society's attitude toward wastes. Wastes must not only be "put down", they must be put down properly. Individuals, business, industry and government have specific responsibilities, and opportunities, to manage wastes in a way which can reduce economic, environmental and social impacts.

ROLE OF THE INDIVIDUAL

With the exception of anti-litter laws, dog scoop bylaws and car emission guidelines, legislation which directly affects the way individuals dispose of their wastes is scarce. The few laws which govern the individual's responsibilities in waste management are not practised universally and are poorly enforced. Consequently, individuals concerned with improving waste management must adopt personal guidelines and habits.

There are many reasons for individuals to practise improved waste management, regardless of legal responsibilities.

The simplest way for individuals to help alleviate waste management problems is to practise the three "Rs" of waste management:

(1) *Reduce* the amount of resources used and the amount of waste produced in the home. This is called *source reduction*.

(2) *Reuse* appropriate items numerous times in their original form. For example, many beverage bottles and other glass containers can be reused 40 times or more before they need to be replaced.

(3) *Recycle* materials such as paper, glass and metal so they can be used to replace "new" resources in the manufacture of various goods.

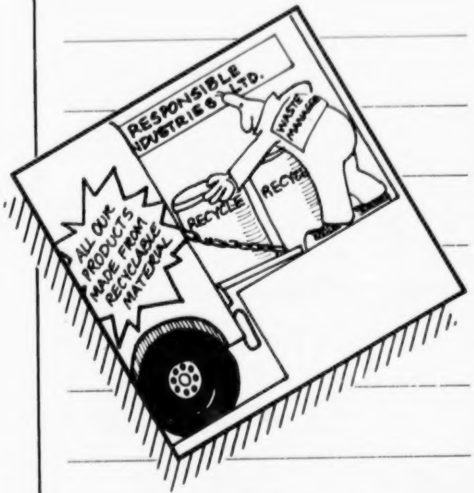
In addition to practicing the three "Rs", individuals can contribute to improved waste management by:

(1) becoming a more discriminating consumer;

(2) helping educate other people about the costs and benefits of waste management and resource recovery;

(3) participating in a recycling project.

ROLE OF BUSINESS AND INDUSTRY


RESPONSIBLE INDUSTRIES LTD.
WASTE MANAGER
RECYCLE
RECYC
ALL OUR PRODUCTS MADE FROM RECYCLABLE MATERIAL

Industry is often accused of generating wastes which cause social and environmental problems. Most businesses and industries, however, approach waste management in a more responsible manner than many individuals. This may be because industry is more heavily *regulated* than individuals and has *guidelines* to follow, as well as responsibilities to meet. Industries must obtain *permits* before they can release any liquid, solid or gaseous wastes. The few industries which are slow to meet the guidelines, or try to side-step them, give the entire industrial sector a bad name.

At present, most industries manage their own wastes by treating and/or disposing of them on-site. There are many examples of B.C. industries which have adopted waste management practices like recycling, waste recovery and waste exchange.

An example of a waste management problem which has been partly resolved by good waste management practices involves one oil company's solution to dealing with some of the millions of litres of used lubricating oil produced in B.C. each year. According to a recent study, it is estimated that between one and seven million litres of used motor oil are currently sprayed on provincial roads and highways, about four million litres are disposed of inappropriately on land and/or in water and about 20 million litres are burned. Such disposal methods are not satisfactory. Road oil, for example, can seep into streams and waterways. Dumping can contaminate both land and water, while burning oil can cause undesirable emissions such as PCBs (polychlorinated byphenyls), PNAs (polynucleated aromatics) and lead.

Used oil is not worn out but it is contaminated. By removing the *contaminants* and *additives*, a new *base stock* can be produced. The most appropriate way to manage used motor oil would be to reprocess it into new base stocks for lubricants. The base stock could then be combined with the necessary additives to produce hydraulic, lubricating or other oils.

MOHAWK OIL PROJECT

Since 1982, Mohawk Oil has spent million of dollars developing a process and building an oil re-refining plant in North Vancouver. In 1984, Mohawk Oil was able to reprocess more than 13.5 million litres of oil and the capacity was to be increased to 32 million litres by 1986. The used oil is obtained from service stations, mining operations, fleet vehicle operators, trucking companies, bus companies and its own chain of retail outlets. (Members of the general public can take their used motor oil to any Mohawk station.) In some instances, Mohawk obtains the used oil for the cost of transportation. In most cases, however, the oil is purchased at prices which vary depending on the volume, quality and location.

The used oil goes through a three-stage re-refining process:

(1) dehydration — water and residual gasoline are removed,

(2) vacuum distillation — contaminants and worn-out additives are removed.

(3) hydrotreating — this final step is widely recognized as the best way of treating oil to obtain an almost clear, high quality base stock.

It is interesting that hydrotreating involves the use of hydrogen gas which is purchased from a neighbouring chemical plant, where it is considered as a waste "byproduct".

The 13.5 million litres of used oil recycled each year provide about 9 million litres of new base stock. The remaining 4.5 million litres are used in the following ways:

(1) lighter fraction which is re-refined into diesel fuel.

(2) residue bottoms which are used by the paving industry as an asphalt extender.

(3) a caustic byproduct which is used by the pulp and paper industry.

Mohawk Oil is an example of a company which has taken advantage of the inter-related nature of resource use, waste production and resource recovery to make a profit while solving a problem.

There are other examples of resource recovery projects in the forestry, pulp and paper, metal smelting and chemical industries. All of the kraft pulp mills in B.C., for instance, burn "black liquor" which is the chemical byproduct of the digestion process. Kraft pulp mills do this for three reasons:

(1) to dispose of a waste product

(2) to produce energy which is used in the mill

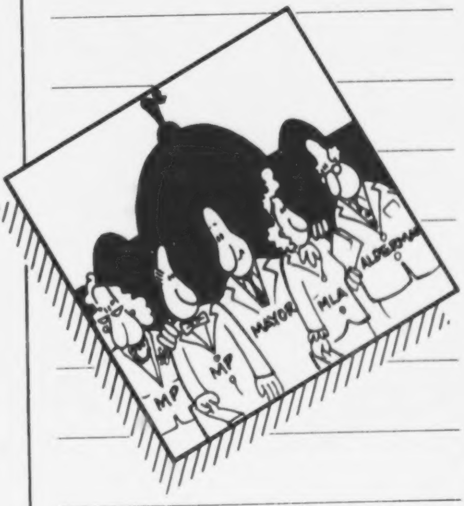
(3) to recover a high percentage of chemicals which are recycled into the pulping process.

Unfortunately, many industries are not making full use of resource recovery opportunities. As the price of resources increases, however, resource recovery opportunities which were not economic a few years ago may soon become financial necessities. Existing opportunities for improved waste management include:

- recovering and reusing the chemicals in photograph processing laboratories;
- standardizing the chemical make-up of common plastics to facilitate plastic recycling;
- using recycled paper and glass in the production of newsprint and bottles;
- recovering fly ash from gaseous emissions and using it as a cement substitute, a road base or a soil nutrient.
- recovering sulphur for use in concrete, as a protective coating, asphalt extender and asphalt replacement;
- converting food wastes into fertilizers, animal feeds and base materials for ethanol (fuel alcohol) production;

ROLE OF GOVERNMENT

The federal, provincial and municipal levels of government each have different roles to play in waste management.



ROLE OF THE FEDERAL GOVERNMENT

The government of Canada has little direct *jurisdictional* control over the treatment, management or disposal of wastes unless the wastes cross provincial or national boundaries. The Environmental Protection Service (EPS) of Environment Canada "promotes environmental quality by identifying pollution problems, then developing, implementing and enforcing protection requirements." EPS is concerned with air and water pollution, waste management, ocean dumping, environmental contaminants, environmental impact assessments and environmental emergencies.

The Pacific and Yukon Regional activities of EPS include:

— inland and ocean water biological and monitoring
— surveillance of ocean dumping sites and issuing of ocean dumping permits
— shellfish water quality surveys
— contaminants control, including pesticides
— advice on technology programs for air, water and waste management
— monitoring of air pollution; coal dust studies, fuel regulations (lead in gasoline)
— monitoring of industrial effluents; mine tailings, pulpmill wastes; industrial chemicals as well as municipal sewage, refuse disposal and landfills
— implementation of effluent and air regulations or requirements
— coordination and response to environmental emergencies like oil and chemical spills
— clean-up and prevention inspections and advice for pollution control at federal activities
— clearing house for referrals concerning waste management from federal departments or agencies, provincial governments and industry

The federal legislation for these activities includes the *Clean Air Act*, the *Canada Water Act*, the *Environmental Contaminants Act*, the *Ocean Dumping Control Act* and pollution control provisions of the *Fisheries Act*.

The federal government also supports programs which help reduce or reuse wastes. A federal program called Development and Demonstration of Resource and Energy Conservation Technology (DRECT) pays 50% of the cost of developing new technology to aid in the recovery or reduction of wastes. Other related federal initiatives include programs such as Enerdemo, Forest Industry Renewable Energy and the Canadian Energy Audit Program. These programs are designed to help businesses reduce their energy consumption and develop technologies which could save energy, reduce waste, recover resources or use renewable forms of energy. The federal government, along with the provinces, also provides funds for the Canadian Waste Exchange Program which assists industries in exchanging their wastes.

Job creation programs like Canada Works, and the provincial government's Extended Opportunity Program or Summer Youth Employment programs, also provide funds for recycling or other resource recovery projects.

ROLE OF THE PROVINCIAL GOVERNMENT

The provincial government plays the major jurisdictional role in the management, treatment, transportation and disposal of wastes.

The goal of the waste management program of the B.C. Ministry of Environment is:

"To manage waste materials for the protection of the environment and the conservation of energy and resources."

The aims of the program include:

1. To regulate discharges of wastes into the environment of British Columbia through a licensing system which controls the quantity and quality of the discharge, and to amend such permits or licences to meet changing circumstances.
2. To monitor waste discharges and their effects on the receiving environment to ensure compliance with permits and control of pollution.
3. To enforce the provisions of the *Waste Management Act*.
4. To initiate investigations and research into problems associated with waste discharges and their effect upon the receiving environment.
5. To undertake special studies on the impacts of materials, products and wastes on the environment.
6. To maintain an inventory and data bank on waste discharges and environmental quality to assist surveillance functions and enable planning activities.
7. To administer and enforce the *Litter Act*.
8. To safeguard the environment by the development of programs designed to prevent and clean up spills of hazardous materials.

9. To inventory and classify materials now being wasted within the province.
10. To develop plans and procedures for alternate uses of materials now being wasted, and to coordinate the implementation of programs.
11. To provide an informational service regarding waste material and environmental quality.
12. To develop procedures, standards, objectives and guidelines to achieve the goal of the program.
13. To promote joint planning processes and decisions in waste management.
14. To help other levels of government solve of their waste treatment and disposal problems.

In addition, the Ministry of Environment has established pollution control objectives and guidelines for the following:

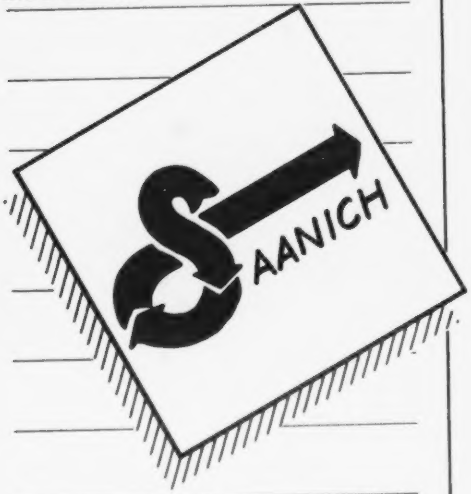
— forest products industries
— chemical and petroleum industries
— mining, smelting and related industries
— food processing, agricultural and other miscellaneous industries
— municipal liquid and solid wastes
— municipal effluent application to land

ROLE OF MUNICIPAL GOVERNMENT

Municipal governments probably play the most visible role in the management of wastes. Each municipality is responsible for the collection and disposal of solid and liquid domestic wastes in its area. In some cases, regional districts are responsible for one or both of these tasks. Municipalities, like industries, must obtain permits from the provincial government to discharge any wastes. Until recently, each discharge required its own permit. New legislation allows municipalities, either individually or in concert with other municipalities, to submit a "Waste Management Plan". Such a plan can encompass all discharges in any category and level over an extended time period and replace permits.

The plan may include provisions for special treatment of wastes. The City of Kelowna and the Comox-Strathcona Regional District provide two examples of what can be done to alleviate the problems of *sludge* (the semi-solid waste which remains after sewage has been treated). In these areas, the sludge is mixed with wood wastes, such as wood chips or sawdust, and the mixture is *composted*. The high temperature which occurs during the composting process kills the *pathogens* (organisms which cause disease) in the sludge. The composted sludge then can be sold or given away for use as a safe fertilizer.

Municipalities can also develop local or regional recycling programs. The Municipality of Saanich on Vancouver Island, for example, supports a curbside collection program to recycle paper, glass and metals.



SAANICH PROJECT

Two factors which helped the Saanich project to become a success were:

(1) In 1984, the Capital Regional District began charging a user fee of $8.50 per tonne for disposing of garbage at the landfill. This provided the municipality of Saanich with a direct incentive to reduce the volume of their garbage.

(2) In an effort to reduce tonnage and encourage recycling, the municipality passed a bylaw prohibiting the disposal of newspaper as garbage.

The Saanich curbside collection program started in 1981 with a pilot project in a neighbourhood of 2000 homes. In 1984, the curbside project was expanded to include 5300 homes. The municipality was hoping to further expand the curbside pickup to include 23 000 homes by the end of 1985. In addition, 4000 households in low density or rural areas of Saanich have nearby drop-off depots for recyclable materials. In 1984, about 270 tonnes of paper, 135 tonnes of glass and 35 tonnes of cans were recycled.

The participation rate (the percentage of households which recycle) has been outstanding, with 65 to 70% of all households separating their paper, glass and cans for separate collection. Householders are loaned large white pails for glass and metals. In addition to serving as a reminder to householders, these pails make it relatively easy to separate and recycle household wastes. In doing so, householders must adhere to standard *source separation guidelines* which include:

- papers must be neatly bagged or tied in bundles.
- glass must be rinsed and all metal tops or collars removed.
- metal cans must be rinsed, labels removed and then flattened.

When the project first started, the Municipality of Saanich and its Citizens Advisory Committee on Recycling had a great deal of involvement. Now, however, their responsibilities are minimal.

The entire project, which has grown to be the second largest in Canada, is now organized and operated by the Saanich Recycling Society, a non-profit society which employs handicapped people. The society pays for the recycling operation through the sales of the recycled material and a $29,000 grant from The Municipality of Saanich.

This type of commitment to resource recovery is an excellent example of how a municipality can take a leading role in encouraging citizens to recycle. The progam recently received a special Award of Merit from the provincial government in recognition of the municipality's recycling efforts.

LEGISLATION

In order for a government or agency to control the release of wastes into the environment, there must be guidelines to enforce. At the federal and provincial levels, the guidelines are contained in *Acts*. At the municipal level, the guidelines are embodied in *bylaws*. While legislation provides broad guidelines for waste management, specific details regarding types, components and levels of effluents and/or ban or control of specific compounds are contained in what are known as *regulations*.

FEDERAL LEGISLATION

A number of Acts passed by the government of Canada deal with waste management.

1. *Clean Air Act*

   This Act sets standards for the emission of harmful substances which may be released into the air. Air emission regulations and guidelines have been adopted under the *Clean Air Act* for the following substances:

- lead
- asbestos
- vinyl chloride
- mercury
- concentration of lead in motor fuels

Recently, the federal government announced plans to reduce the lead content of gasoline by 91% under this Act.

2. *The Fisheries Act*

   This Act provides guidelines and regulations for the control of pollutants into receiving waters inhabited by fish. Fishing is an important industry in Canada and maintaining water quality is imperative.

Guidelines and regulations have been developed for the following industries under the *Fisheries Act*:

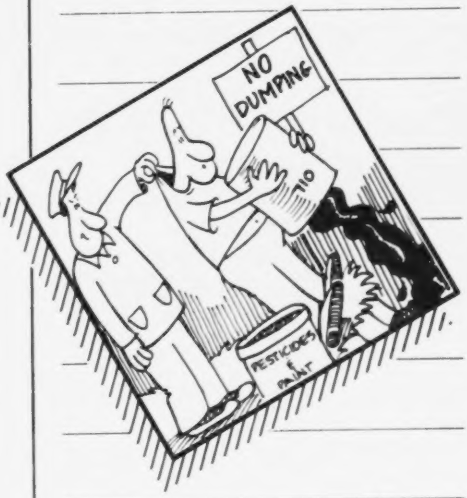
- pulp and paper
- petroleum
- base metal industry
- metal finishing
- chlor-alkali (mercury)
- fish processing
- meat and poultry

There is a provision in the Fisheries Act for individuals or groups to collect evidence and lay charges against anyone who exceeds the amount of waste discharges allowed by the law. Once the charges have been laid and the evidence is verified, a Crown attorney is appointed to prosecute the case in court.

In 1980, for example, a naturalist charged two companies with contaminating three creeks which flow into the lower Fraser River.

The companies were accused of ignoring permit requirements and putting waste gypsum wallboard, office garbage, creosoted timbers and wood wastes into a landfill. The naturalist arranged for laboratory tests on the *leachates* from the landfill. The tests proved that, after a rain, leachates were entering the Fraser River.

The companies were convicted on four counts under the federal Fisheries Act and fined a total of $28,000. Both sides were to appeal the decision.



3. *The Ocean Dumping Control Act*

   This Act enables Environment Canada to prohibit, or control by permit, disposal of wastes at sea that could harm the marine ecosystem.

4. *The Canada Water Act*

   Regulations to control the amounts of phosphorus and phosphates in laundry detergents established to provide a measure of control against eutrophication of water.

5. *The Environmental Contaminants Act*

   This legislation enables the establishment of regulations prohibiting all uses of mirex, polychlorinated teraphenyls and polybrominated biphenyls. The regulations also restrict the use of polycholorinated biphenyls (PCBs) and prohibit the use of chlorofluorocarbons in certain aerosol sprays.

Other federal measures have also been passed which indirectly assist in waste management tasks such as the "gas guzzler tax" which discourages the production or importation of cars which have poor gas mileage. Reduced gas consumption results in reduced levels of pollution.

PROVINCIAL LEGISLATION

In B.C., the *Waste Management Act* (1982) is the main legislation governing a wide range of waste management issues.

This Act is a combination and expansion of powers and guidelines previously contained in the *Pollution Control Act* and the *Litter Act*. It includes the following:

1. The Minister has the power to approve waste management plans submitted by municipalities for the collection, handling, treatment and disposal of municipal wastes such as sewage and refuse.
2. The responsibility for day-to-day decision making regarding the issuance of permits and approvals placed in the hands of the Regional Managers of the Ministry of Environment.
3. Permit applicants may appeal decisions of the Regional Managers to the Director of Waste Management.
4. The Act provides authorization for the control and storage of special (hazardous) wastes. Provisions are made to designate a waste as a special waste, based on its composition and quantity or the situation in which it is produced.
5. A "cradle to grave" tracking system is included to check that special wastes in transit arrive intact at their predesignated destinations.
6. The Minister may require "spill prevention measures" to be established and plans prepared for response to spills of substances which may harm the environment. Where spills do occur, the person or group responsible must report them immediately.
7. Local governments can obtain authority to restrict or control the types and strengths of wastes being discharged into their treatment facilities. This will prevent wastes such as heavy metals, chemical or toxic compounds from entering facilities which are not designed to treat them.
8. The Act controls beverage containers by requiring that a refund be paid on the return of containers to keep them out of the litter and landfill waste streams.
9. Substantial penalties for offenses are specified with fines ranging from $2,000 for littering to $50,000 for storing or releasing special wastes in contravention of a permit.

> The province prosecutes polluters which violate the Waste Management Act. In 1980, for example, government officials investigated permit holders along the lower Fraser River. Of the 40 operations investigated, 21 were found to be in compliance with their permits, while 19 were guilty of discharging wastes in excess of their permits. As a result of the investigation, 51 charges were laid against 16 of the 19 operations.

MUNICIPAL BYLAWS

Most municipalities have bylaws which authorize them to collect, transport and dispose of household refuse. These bylaws also establish the terms and conditions under which the collection takes place. They may set rates for collection from commercial ratepayers and specify the types of wastes which may or may not be discarded. For example, the City of Vancouver's *Refuse Bylaw* prohibits discarding the following types of materials for refuse collection:

- — liquids
- — radioactive materials
- — dead animals
- — explosives
- — materials which present a fire hazard
- — offal (animal slaughtering wastes)

Most municipalities also have a bylaw which specifies the types of materials which may be discharged into the sewerage system. Specific restrictions and conditions are frequently applied on an individual basis with those industries which have to dispose of liquid wastes.

Bylaws can also facilitate resource recovery and recycling. The Saanich bylaw prohibiting discarding newspapers is an excellent example.

Module Six Terms

Act
additive
base stocks
bylaw
composted
contaminants
guidelines
jurisdiction
leachates
legislation
pathogen
permits
recycle
reduce
regulation
reuse
source reduction
source separation guidelines
sludge

NOTES

MODULE 6.10

MODULE #6 — QUESTIONS, PROJECTS AND ACTIVITIES

1. Define the following terms:
   - (a) legislation
   - (b) regulations
   - (c) Act
   - (d) jurisdiction
   - (e) bylaw
   - (f) sludge
   - (g) pathogen
2. Identify and summarize the roles which each of the following plays in waste management:
   - (a) individuals
   - (b) business and industry
   - (c) government
3. Governments have a responsibility to ensure proper waste management practices are implemented. Give at least one example of how this has been accomplished by each of the following levels of government:
   - (a) federal
   - (b) provincial
   - (c) municipal
4. The location of sanitary landfill sites must be approved by local governments. However, site selection is a complex, lengthy and controversial process.
   - (a) Investigate and identify the criteria for a "good" sanitary landfill site.
   - (b) Interview a local or regional official to determine why the exisiting regional landfill site(s) were chosen. How long is the present landfill site expected to be used? How will the exisiting landfill site be replaced when the time comes?
   - (c) Study maps of your area to determine existing and possible locations for future landfill sites. Give reasons for your site selections.
   - (d) What effects can the location of a landfill site have on the surrounding area?
   - (e) Develop a display based on the information you have collected. Make arrangements to set up the display at a mall, community centre, library or science fair.
5. **The following is a teacher directed activity** — The B.C. Ministry of Environment publishes "Pollution Control Objectives" for industries and municipalities in the province.
   - (a) Divide the class into four groups and ask each to investigate and summarize the general pollution control objectives for the following:
     - — Chemical and petroleum industries
     - — Food processing and agricultural industries
     - — Forest products industries
     - — Municipal waste discharges
   - (b) Compare and contrast the pollution control objectives for each group of waste producers.
   - (c) Evaluate the control objectives in order to determine which group or groups appear to have the strictest control objectives and why?
6. Who "owns" and is responsible for waste? Organize a debate on this topic in your classroom.
7. The B.C. Ministry of Environment recently commissioned a province-wide public opinion poll regarding waste management.
   - (a) Obtain a copy of the the fact sheet entitled "Getting the Answers: Conducting Surveys on Environmental Issues", which includes some of the results of the poll and suggested survey questions, by writing to the Information Services Branch of the Ministry of Environment in Victoria. You can take your own survey using the information provided on the fact sheet.

8. Develop your own questionaire to gather information in your community concerning people's ideas regarding present and future waste management alternatives. Include questions such as:
   - — Do you feel there is adequate public information regarding waste management issues?
   - — What does the term recycling mean to you? What does it involve?
   - — Do you currently recycle any of your household wastes?
   - — Have you ever heard of the *Oil Save* Program?

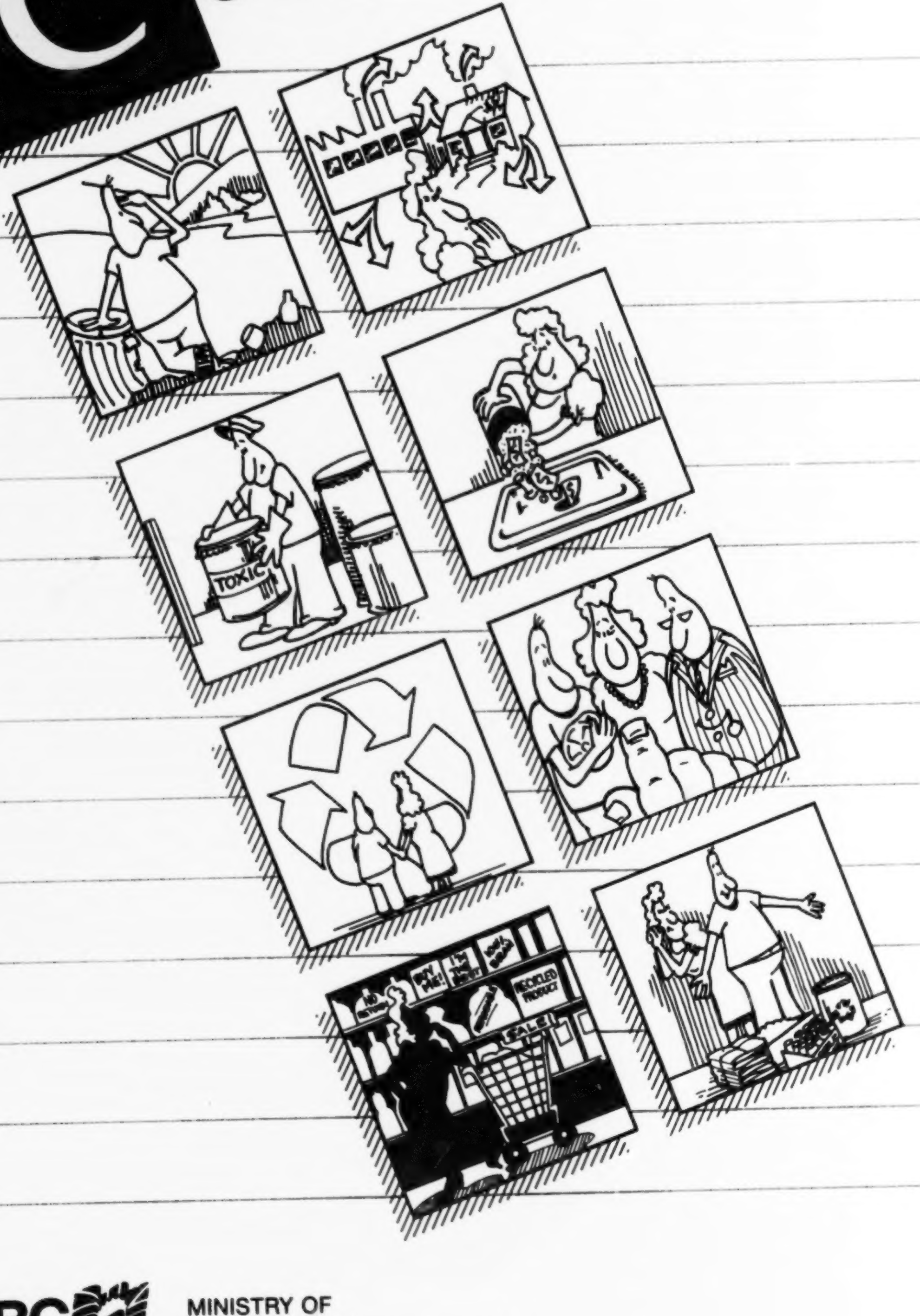
   (a) Interview at least 10 people in the community and develop a summary report based on the results.
   (b) Compare your findings with the results of the provincial survey.
   (c) Write a letter to your city or municipal council and to the B.C. Ministry of Environment detailing the results of your poll.

9. Much of the controversy surrounding waste disposal (e.g. the selection of a sanitary landfill site) is caused by what is known as NIMBY ("Not In My Backyard")
   (a) Why is NIMBY such a common attitude in our society?
   (b) How do governments deal with the "NIMBY" attitude?
   (c) Do societies from other areas of the world share the NIMBY attitude toward waste management?
   (d) Compare and contrast the possible reasons for the different attitudes.

NOTES

MODULE #7

CONSUMER CHOICES



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TEACHER'S PAGE

MODULE #7

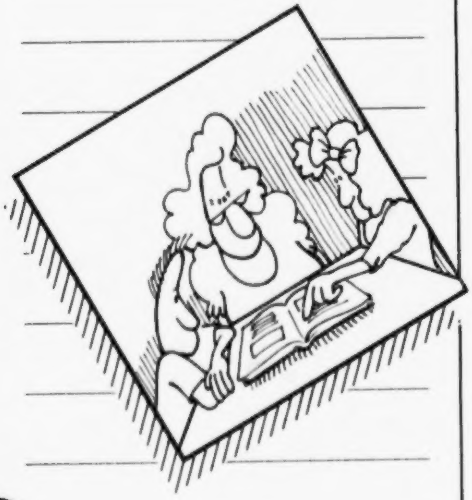
CONSUMER CHOICES

SYNOPSIS

This module explores some of the things that affect consumers' decisions and the effects these decisions have on the types of goods produced and wastes generated.

PURPOSE

To understand factors which affect consumers' decisions and the effect which consumer decisions can have on waste production and management.



LEARNING OUTCOMES

Students will be able to:

- (a) identify and explain the factors which affect consumer decisions
- (b) demonstrate some of the impacts which consumer choices can have on both waste management and the environment using examples from their own experiences.
- (c) examine and analyze the amount and type of garbage generated in their own homes
- (d) compare the quality of similar products

CONTENT OUTLINE

1. Factors Which Affect Consumer Decisions
   - (a) "needs" and "wants"
   - (b) peer influence
   - (c) advertising
   - (d) convenience
   - (e) ability to pay
2. Effects of Consumer Decisions
   - (a) market response to consumer decisions
   - (b) illustrate how consumer choices affect things such as:
     - — the design, packaging, availability, durability, cost, etc. of various products
     - — questions to ask before purchasing a product

Suggested Use	Time Required
Science 10 Social Studies 10 Consumer Education Environmental Education Directed Studies	1–2 hours

Module #7 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports, and publications dealing with various aspects of resource recovery and use such as "Motivating People To Recycle", *Resource Recycling*, May/June, 1984.
2. The other teaching aids in the Resources and Wastes package including; #1 "Resources and Wastes" #2 "Wastes Streams", #3 "Waste Management", #4 "Wastes Costs", #5 "Resource Recovery", #6 "Roles, Responsibilities and Legislation", and #8 "Getting Involved".

MODULE #7 — REFERENCES AND RESOURCES

Environmental Management and Public Participation, Canadian Environmental Law Research Foundation, Ottawa, Ontario, 1977

Guidelines For Recovering Residential Waste Materials Through Source Seperation, Waste Management Advisory Board, Toronto, Ontario, 1980

Guidelines For Recovering Used Motor Oil from Do-It-Youself Oil Changes, Waste Management Advisory Board, Toronto, Ontario and Environment Canada, Ottawa, Ontario, 1981

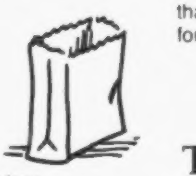
UPDATES

HOW AND WHAT TO RECYCLE

SOURCE SEPARATION — means setting aside recyclable materials like paper, cardboard, glass and metals from wastes in your household or business. Successful recycling depends on materials not being mixed with garbage or other types of recyclables.
FOR MORE INFORMATION CALL Ministry of Environment 387-4321.

Newspapers

Pile in 12" bundles. Secure with twine. No magazines or phone books.

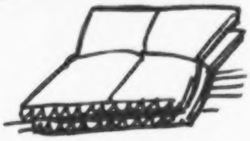


Brown Grocery Bags

No bags of other colors. Printing on bag OK. Bag or box.

Magazines

Bundle or box.



Corrugated Cardboard boxes

Flatten, bundle, tie with twine. No cereal or shoe boxes, waxed or plastic-coated cardboard. Egg cartons OK.

Office Waste Paper

Includes white or colored ledger, computer paper and cards. Box or bag.

Glass

Rinse, remove lids, caps or neck rings. Paper labels OK. Color sort — green, brown, flint. Bag or box. No window glass, pyrex or drinking glass.

Bottles

Most pop and beer bottles returned for refunds. Depots which take them are listed in the Yellow Pages under *Bottles — Used*, or return to retail place of purchase.

Plastics

Recycling plastic waste is difficult especially on a small scale. Since no market exists it is best not to accumulate more plastic than you can *reuse* yourself. Plastic pop bottles can be returned for refund.

Tin Cans

Rinse, remove labels. Remove ends and put in with cans, flatten. Box or bag cans. No lids or bottle caps.

Aluminum

Clean and flatten, all foil, food and non-refundable beverage containers. No foil with paper adhering. Also recycle pots, pans, lawnchair frames, and kitchen utensils.

Other Metals

Household scrap which can be sold for recycling include household appliances, pipe, sheet metal, machinery parts, lead batteries and copper. A list of scrap metal dealers will be found in the Yellow Pages under *Scrap Metal*.

Used Motor Oil

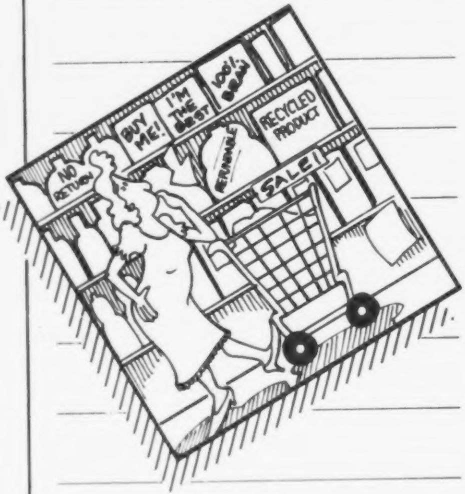
Place in unbreakable, closed containers. Return to an **Oil Save** Depot.

Food and Garden Waste

Food and garden wastes make up one-third of household waste. Composting is a means of processing these wastes into an enriching soil conditioner for your garden while diverting a significant amount of material from your community's solid waste stream. Information on how to compost is available from Waste Management Branch, Ministry of Environment or Horticulture Branch, Ministry of Agriculture.

CONSUMER CHOICES

Consumer decisions significantly affect both resource use and waste production. To understand how consumer decisions can affect resource use and waste production, it is necessary to examine some of the factors which influence consumption.



FACTORS WHICH AFFECT CONSUMER DECISIONS

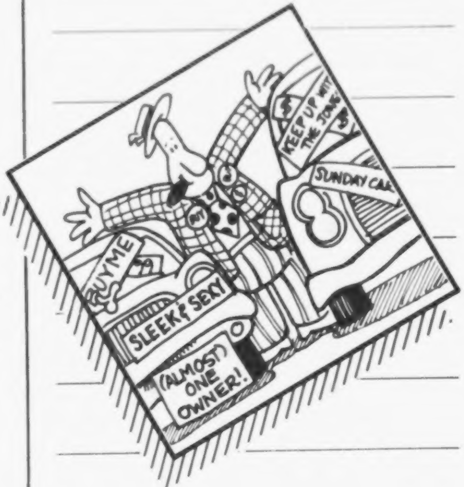
A number of factors influence consumer decisions but the nature of the influence varies from one person to another.

1. NEEDS AND WANTS

A primary motivating factor in people's lives is their *needs* and *wants*. Needs may be defined as those things which everyone requires, or has a right to expect, in life. Wants are those things which are over and above basic needs. In our society, needs include such things as food, shelter, clothing, clean water, transportation, basic education and health care. Everyone *needs* a coat during the winter months. They do not, however, need the latest, most fashionable ski jacket available. Because most British Columbians are able to satisfy their basic needs, a significant portion of their consumer decisions are motivated by wants.

2. PEER INFLUENCE

Most people are affected by the people around them — their family, friends and those with whom they work or go to school. What those around us say, think and feel influences most of the decisions we make including what products we buy and what services we use.



3. ADVERTISING

Advertising is used to present a particular point of view or to persuade the consumer to purchase a specific product. While advertisements are useful in that they provide information about a product, they usually contain biased information.

Psychology plays a big part in advertising. Advertisers carefully consider how people think and what may influence their actions. Advertising techniques have been developed for different types of consumers. Some of the approaches include:

- emphasizing conformity (everybody uses this product);
- encouraging imitation ("Do as I do");
- appealing to snobbery (be the first on your block to have this luxury car);
- offering well being (use this product and you'll feel great);
- enhancing sex appeal (use this product and women/men will throw themselves at you).

The following chart presents some of the pros and cons of advertising as far as good consumerism is concerned.

Advertising

Pros	Cons
— Provides information	— Exerts pressure to buy
— Allows for comparisons	— Causes some people to buy what they may not need
— Saves time shopping	— Presents a one-sided view
— Stimulates competition	— Can be misleading
— Stimulates the economy	— Is costly, therefore adds to product price
— Finances services	

Advertising not only influences the value which people place on products and services, it may convince people to consume beyond their needs or their ability to pay. Cautious consumers realize it is their responsibility and to their benefit to become well-informed about products, by doing such things as comparative shopping and reading consumer magazines, before making a purchase.

4. CONVENIENCE

Saving time is an important factor in many people's lives. As a result, people are attracted to goods and services which are "quick", "convenient" and "easy-to-use". The price of convenience, however, is often hidden.

Some of the costs associated with convenience are:

(a) Monetary costs — Convenience stores are open 24 hours a day so their prices must be higher to help pay for the extra costs of operation.

(b) Health costs — Convenience foods such as frozen dinners and the food served by fast food restaurants may be quick and inexpensive, but are often high in calories and unsaturated fats and not as flavourful or nutritious as home cooked meals.

(c) Environmental costs — While disposable products are convenient to use, they add large quantities of waste to the environment. In addition to the direct disposal of the product by the buyer, there are wastes produced in the manufacturing process.

While it may be acceptable in the short term to pay more for a product because of its convenience, in the long term the added cost of disposal, as well as the increased waste of resources may not be acceptable.

5. ABILITY TO PAY

Income affects consumer decisions. As income levels rise there is a direct correlation with increasing "wants". A lower income family may have to be satisfied with only public transit, or one vehicle, while a family with a larger income may be satisfied only when they have two or more vehicles.

The ability to buy items on credit also influences consumer spending. The use of credit can lead to the purchase of items which people cannot really afford.

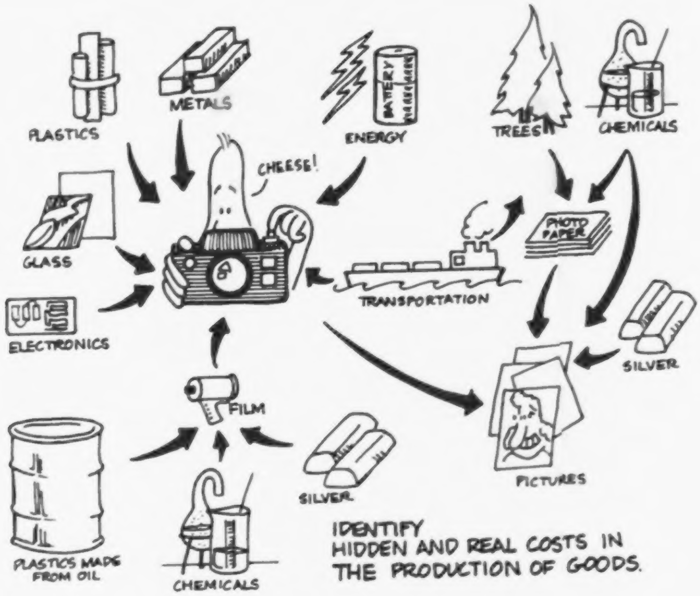
EFFECTS OF CONSUMER DECISIONS

Consumer decisions influence which products are sold, how they are packaged and how well they are made.

Although the marketplace tends to react slowly, it does respond to consumer demand. The "energy crisis" of 1973, for instance, led to an increase in demand for smaller, more fuel-efficient cars. At first, the small car was viewed as an economic necessity but, before long, it became a status symbol. Initially, the demand for smaller cars was filled by foreign auto makers because Canadian and American producers were not able to meet the need. In fact, several years passed before the domestic auto industry was able to "re-tool" its factories in order to manufacture smaller cars. Now, the smaller, more fuel-efficient cars represent a major portion of the domestic auto makers overall production. This change in automobile production illustrates how consumers can influence the types of goods which are produced.

Every product is composed of a number of resources. We can gain a better understanding of the diversity of materials used and wasted in the manufacture of a product, by examining the resources needed to produce a colour photograph. To take a picture one needs a camera. The camera is composed of metal, glass, rubber and/or plastic. To get the metal, machines which use a great deal of energy extract ore from mines. Large amounts of mine wastes (overburden and tailings) are produced when the mineral is separated from the rock before the various ores can be shipped to a smelter. The ore is shipped by boat or rail which uses energy and creates wastes. At the smelter, energy is used to refine the different ore into metal, creating waste in the process. A similar pattern of resource use and waste production takes place during in the manufacture of the glass, rubber and plastic components of the camera. All of the materials required are then shipped to the factory, where the camera is made.

In addition to the camera, there is film, developing fluid and photographic paper needed to produce the print. Each of these components uses resources and produces wastes when it is manufactured.



If the example of the camera were multiplied millions of times, it is easy to see how so many resources are used and so much waste is produced. Before purchasing a product, discriminating consumers take time to check a consumer guide and ask themselves questions:

1. Do I really want or need this?
2. What do I expect it to do for me?
3. If I don't buy this product, what alternative products are available?
4. Is this product recyclable or reusable?
5. Does the manufacturing process used to make this product create an undue amount of waste?
6. Is the product disposable or of poor quality?
7. Is the product made out of renewable or non-renewable materials?

8. How much care and maintenance will be required to keep the product in good shape or working order? Do I have the time and the motivation to maintain the product properly?
9. What will happen to the product when I no longer have any use for it?

Often people do not ask these questions when making a purchase. As some resources become less abundant, and if waste management problems worsen, an increasing number of people will have to consider these issues.

Discriminating consumers also observe the way products are packaged.

Packaging has been used in one form or another ever since humans began transporting goods. In the last few decades, however, the use of packaging has increased dramatically. Modern-day packaging is used for:

1. Sanitation — to prevent contamination from dirt or insects
2. Protection — to prevent theft of, or damage to, a product
3. Communication — to allow an attractive display and a message to be presented to the consumer
4. Containment — to divide products into manageable sizes
5. Convenience — to make products easier to dispense.

Packaging itself is not necessarily wrong or bad. The use of packaging for sanitation purposes are essential. Extra packaging strictly for advertising purposes is another matter. The problem is that *excess* packaging uses valuable resources, costs money (an average of 10 cents of every dollar spent on a product goes to packaging) and is wasteful. (On average, 90 per cent of the packaging ends up in the waste stream. In B.C., packaging accounts for an estimated 30% of all municipal solid wastes.) According to the United States' Environmental Protection Agency, a package is excessive if:

- it is made out of a material in short supply;
- the amount of energy required to produce it is large in relation to alternative forms of packaging;
- it is made of materials which are difficult to dispose of and more satisfactory alternatives are available;
- it hinders consumer use of a product (by being difficult or hazardous to use).

If consumers feel that product packaging is excessive, they may be able to purchase an alternative product which is more appropriately packaged.

If consumers rejected products which are over-packaged, disposable, of poor quality and whose manufacture creates a lot of pollution, then the demand for these types of goods would likely be reduced. Consequently, suppliers would produce fewer of them. By purchasing only well-made products, consumers can help to create an increased demand for more durable goods. Although better made products may cost more initially, they tend to last longer and often end up being less expensive in the long run.

Personal decisions relating to transportation can also affect the reduction of wastes. If more people used public transit, especially during "off-peak" hours, then the system would be able to pay a larger percentage of its costs and improve service. Improved service would encourage more people to use public transit and drive their own cars less frequently. In turn, this would result in reduced energy consumption and waste generation, such as air pollution from automobiles.

Since consumer decisions can have a significant impact on both resource use and waste management, it is important that consumers develop a better understanding of the connections between the products they buy and the amount of resources used, as well as the quantity and type of waste generated.

Ultimately, society must resolve the problems associated with resource use and the management of wastes. The solution will undoubtedly require a mix of technological and social changes. These changes will include the reduction and reuse of waste products during manufacturing, political and economic support from government and industry, the integration of recycling with standard methods of handling solid wastes, and a change in the general public's attitude toward waste generation. The responsibility to implement changes lies with individuals, businesses and governments.

The process of change in modern society is generally a slow one. Legislators or business executives sometimes do not respond until a situation can no longer be ignored. In many parts of the world, clean water and air are almost unknown. British Columbia, however, is in a fortunate position: our wastes have not yet seriously harmed our air, land and water. We have the opportunity to deal effectively with our waste problems *before* they become critical. Personal involvement, community education regarding waste management, and public participation are essential elements in this process. *You* can make a difference by getting involved.

Module Seven Terms

excess
needs
off-peak
wants

NOTES

MODULE 7.6

MODULE #7 — QUESTIONS, PROJECTS AND ACTIVITIES

1. A person's "needs" and "wants" have a major effect on consumer decisions.
   (a) Define the terms "needs" and "wants".
   (b) Discuss the difference between "wants" and "needs".
   (c) What factors influence people's "wants" and how?
2. Advertising is influential in determining consumer choices.
   (a) Choose a magazine advertisement for an item which a student "needs". Describe what the advertisement emphasizes to convince the reader to buy the product.
   (b) Choose a magazine advertisement for an item which a student "wants". Describe what the advertisement emphasizes to convince the reader to buy the product.
   (c) Compare the different approaches used to advertise "needs" and "wants".
   (d) Give an example of how advertising has influenced a consumer decision which you have made.
3. Packaging has many purposes including sanitation, protection, communication, convenience and containment.
   (a) Go to a local supermarket and find examples of the following:
      — products that need the protection of packaging
      — products that need special packaging for health reasons
      — packaging that is recyclable
      — products that are overpackaged.
   (b) Present a report based on your findings to your class.
   (c) As an extension activity investigate the history of packaging and make an oral report to the class.
4. Most people do not pay much attention to the amounts or types of garbage generated in their homes. By doing the following project, a family will be:
   - more aware of the amount and types of garbage it generates
   - able to identify ways of reducing, reusing and recycling part of its garbage

   (a) You will need four large plastic bags to collect different components of the family garbage:
      - bag #1 — paper
      - bag #2 — metal
      - bag #3 — glass and ceramic items
      - bag #4 — everything else (keep a record of the different kinds of items that go into this bag)

   (b) After a period of three or seven days (depending on the size of the bag and the amount of garbage), record the weight of each bag, the number of people in the household and the length of time over which the garbage was collected.
   (c) Calculate the amount of each type of garbage discarded per day and week by each person in the family. Calculate the total amount of garbage produced by the family per day and per week.
   (d) Calculate the percentage of each type of garbage produced in the family.
   (e) Calculate the percentage of your garbage that can possibly be recycled or reused.
   (f) Compare the results of your garbage survey with those obtained by other people in the class.
5. Identify some of the impacts which consumer choices can have on the following and give at least one example of each case:

(a) resource use
(b) waste production
(c) waste management
(d) the environment

6. A discriminating consumer will research a product before buying it. Divide the class into groups to compare the different brands of the products which they may be interested in purchasing.
   (a) Design and draw a chart on which considerations such as price, expected life span, and appearance can be listed.
   (b) Report the results of your investigation to the class. From what sources did you gather information about the product? Which brand of the product is the best buy? Why?

7. The processes used to manufacture some products can cause more pollution than the processes used to manufacture other products.
   (a) Choose two similar products that could be substituted for one another (e.g. polyester blouse, cotton blouse).
   (b) Investigate and compare the processes used to manufacture the products and determine the amounts and types of wastes produced.
   (c) Report your findings to the class.

NOTES

MODULE #8

GETTING INVOLVED

BC
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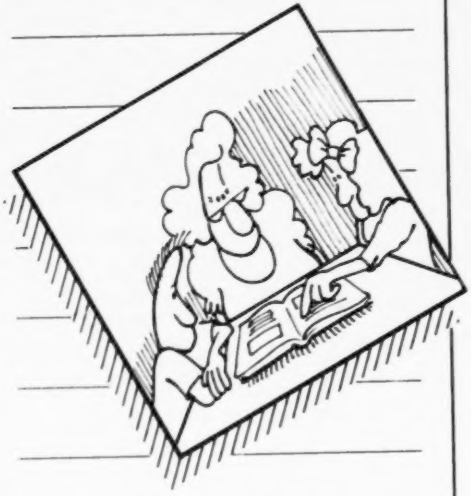


MODULE #8

GETTING INVOLVED

SYNOPSIS

This module describes how individuals can get involved in improving waste management in the home, school and community.

PURPOSE

To identify ways in which individuals can get involved in improving waste management in the home, school and the community.

LEARNING OUTCOMES

Students will be able to:

- (a) identify ways of reducing, reusing and recycling waste in the home, school and community
- (b) demonstrate how to set up a compost pile
- (c) describe the purpose and operation of a local or regional recycling facility
- (d) design a working plan for a school-based recycling project
- (e) participate in the reduction of waste in the home, school or community through individual or group action.

CONTENT OUTLINE

1. Getting Involved
   - (a) identify residential waste management techniques
     - — reducing amount of waste generated
     - — reusing and repairing old items
     - — recycling other items
     - — composting organic materials
   - (b) identify waste management opportunities in the school
     - — reducing the amount of waste generated
     - — reusing and repairing old items
     - — recycling other items
     - — composting organic material
   - (c) identify community waste management opportunities
     - — recycling opportunities in the community
     - — existing and needed recycling facilities
     - — "Separation at Source" guidelines
   - (d) design and undertake a home, school or community recycling project or participate in an existing one

Suggested Use	Time Required
Science 10 Social Studies 10 Consumer Education Environmental Education	1–2 hours

Module #8 can be used in whole or in part, on its own or in conjunction with the following resources:

1. Current articles, reports, and publications dealing with various aspects of resource recovery and use such as "Are There Careers in Waste Recycling", *BioCycle*, January/ February, 1984.
2. The other teaching aids in the Resources and Wastes package including; #1 "Resources and Wastes" #2 "Wastes Streams", #3 "Waste Management", #4 "Wastes Costs", #5 "Resource Recovery", #6 "Roles, Responsibilities and Legislation" and #7 "Consumer Choices".

MODULE #8 REFERENCES AND RESOURCES

Divide and Conquer — Guidelines for School Waste Management Recovery, Ontario Ministry of the Environment, Toronto, Ontario, 1980

Environmental Management and Public Participation, Canadian Environmental Law Research Foundation, Ottawa, Ontario, 1977

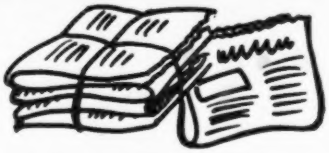
Guidelines For Recovering Residential Waste Materials Through Source Seperation, Waste Management Advisory Board, Toronto, Ontario, 1980

Guidelines For Recovering Used Motor Oil from Do-It-Youself Oil Changes, Waste Management Advisory Board, Toronto, Ontario and Environment Canada, Ottawa, Ontario, 1981

UPDATES

HOW AND WHAT TO RECYCLE

SOURCE SEPARATION — means setting aside recyclable materials like paper, cardboard, glass and metals from wastes in your household or business. Successful recycling depends on materials not being mixed with garbage or other types of recyclables.
FOR MORE INFORMATION CALL Ministry of Environment 387-4321.



Newspapers

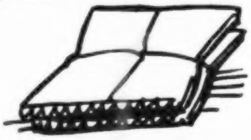
Pile in 12" bundles. Secure with twine. No magazines or phone books.

Brown Grocery Bags

No bags of other colors. Printing on bag OK. Bag or box.

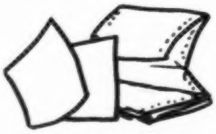
Magazines

Bundle or box.



Corrugated Cardboard boxes

Flatten, bundle, tie with twine. No cereal or shoe boxes, waxed or plastic-coated cardboard. Egg cartons OK.



Office Waste Paper

Includes white or colored ledger, computer paper and cards. Box or bag.

Glass

Rinse, remove lids, caps or neck rings. Paper labels OK. Color sort — green, brown, flint. Bag or box. No window glass, pyrex or drinking glass.

Bottles

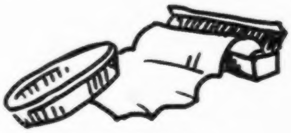
Most pop and beer bottles returned for refunds. Depots which take them are listed in the Yellow Pages under *Bottles — Used*, or return to retail place of purchase.

Plastics

Recycling plastic waste is difficult especially on a small scale. Since no market exists it is best not to accumulate more plastic than you can *reuse* yourself. Plastic pop bottles can be returned for refund.

Tin Cans

Rinse, remove labels. Remove ends and put in with cans, flatten. Box or bag cans. No lids or bottle caps.



Aluminum

Clean and flatten, all foil, food and non-refundable beverage containers. No foil with paper adhering. Also recycle pots, pans, lawnchair frames, and kitchen utensils.

Other Metals

Household scrap which can be sold for recycling include household appliances, pipe, sheet metal, machinery parts, lead batteries and copper. A list of scrap metal dealers will be found in the Yellow Pages under *Scrap Metal*.

Used Motor Oil

Place in unbreakable, closed containers. Return to an **Oil Save** Depot.

Food and Garden Waste

Food and garden wastes make up one-third of household waste. Composting is a means of processing these wastes into an enriching soil conditioner for your garden while diverting a significant amount of material from your community's solid waste stream. Information on how to compost is available from Waste Management Branch, Ministry of Environment or Horticulture Branch, Ministry of Agriculture.

GETTING INVOLVED

People create waste problems, people can solve them. We know how to reduce the amount of wastes generated at the source, how to reuse and recycle many materials and how to recover energy from wastes. The challenge is to find ways of getting people to change their habits and become involved.

GETTING INVOLVED AT HOME

Improved waste management begins at home by *reducing*, *reusing* and *recycling* wastes and resources.

REDUCING

A simple first step is to reduce the amount of resources used and the amount of waste produced in the home. This is called *source reduction*.

1. Reduce the amount of waste generated by carefully assessing items before purchasing them. For example: Is the item overpackaged? Can it be purchased in bulk so you can use your own container? Is it reusable? Can the item be purchased second-hand? What will you do with it when you no longer need or want it? Can it be passed on to someone else after you are through with it? Can a similar item you own be repaired? Can you share the item (e.g. lawnmowers, garden appliances, etc.) with someone else? Does its manufacture generate toxic wastes or large amounts of wastes? Do you really need it.
2. Reduce built-in obsolesence by purchasing durable products which will last longer. Become a more responsible, better informed consumer. Ask manufacturers and retail dealers to provide all of the repair costs, the expected life and the warranty for products. Check manufacturer's claims against product reports in consumer magazines.
3. Reduce the amount of energy used. Turn down the thermostat. Improve the weatherstripping, caulking and insulation of the house. Ride a bicycle, take the bus or walk instead of driving. Try recreational activities which aren't energy intensive such as hiking or cross-country skiing.
4. Reduce the use of herbicides and pesticides. *Read labels carefully.*

REUSING

The second step involves reusing items numerous times in their original form. Beverage bottles can be reused up to 40 times before being replaced. It takes less energy to wash recycled bottles than to make new ones. Other ways to reuse items are:

1. Buy products in reusable containers, such as returnable bottles, and find ways of reusing jars, bottles and cans around your home.
2. Repair broken items to make them last longer and avoid the need to buy new products.
3. Donate old clothes to local charities so someone else can use them.
4. Buy quality used products when possible. Watch for garage sales, go to second hand stores or look in the newspaper for a bargain on a used product before rushing out to buy a new one.
5. Save and reuse things like string, paper clips, rubber bands, paper which is blank on one side, shopping bags, wrapping paper and ribbon.

MODULE 8.2

PROPER PREPARATION OF RECYCLABLES

The old saying, "If it's worth doing, it's worth doing right", is especially true when it comes to recycling. Low quality recyclables (those which are not clean or properly prepared) hinder recycling efforts (increasing the work at the recycling depots and decreasing the marketability of the materials).

Find out how to properly prepare your recyclables. Doing it right the first time will save time and effort all down the line.

Paper:	
Newspaper:	bundle in easily handled stacks or place in large grocery bags. (Check with your recycler to see which is preferred. Some no longer require bundling).
Kraft Paper and Corrugated Cardboard:	(paper bags and heavy postal wrapping paper, and the cardboard with two layers of flat cardboard and a ribbed layer in between) — flatten paper and cardboard (tear it down) and bundle; bag or box.
Scrap Paper:	(non-corrugated cardboard such as shoe boxes or cereal boxes, molded pulp products like egg cartons, junk mail, envelopes with cellophane windows, magazines, catalogues, phone books, etc.) — keep flat and uncrumpled; bag or box.
Ledger Paper:	(high-grade stationery-type paper, sheets with writing, printing, mimeographing, etc., envelopes without cellophane windows) — keep flat; separate white from colored; bag or box. No paper can be recycled if it contains any of the following: food residue, carbon paper, cellophane, paper plates, asphalt or self-sticking tape or adhesives, wax, plastic or foil coating and "wet strength" chemicals (e.g. paper towels, tissues).
Glass:	(any glass container — rinse, remove metal rings, caps and lids; separate by colour (clear, brown and green); labels do not have to be removed; bag or box. Window panes, pyrex and lenses cannot be recycled with container glass because they melt at different temperatures. Metal rings on glass bottles have been a source of frustration to recyclers for years. Although new machines are being tested and developed which will make metal rings less of a problem, at the present time the rings are difficult to separate out. If the rings get into the production process, they can ruin the final product.
Metals:	
Tin Cans:	rinse, remove paper labels, remove both ends and flatten, bag or box. Unflattened cans mean valuable transportation space is lost and more trips with fewer cans need to be taken. At the processing plants, paper and cans with ends intact cause problems with processing solutions.
Aluminum:	(foil and all-aluminum cans which are molded and have side seams) — crush; bag or box.
Motor Oil:	put into a leak-proof container with a lid and take to a recycling depot.
Organics:	
Food and Garden Waste:	use your organic trash (orange peels, etc.) and garden weeds to form a compost. This compost can be used to enrich your soil with nutrients.
Plastic:	plastics can be recycled but it requires that plastic be completely free of all contaminants and sorted into identical types.
Residuals:	all you really need to put in the garbage can is what's left, which might include plastics, mixed packaging, worn out items, etc.

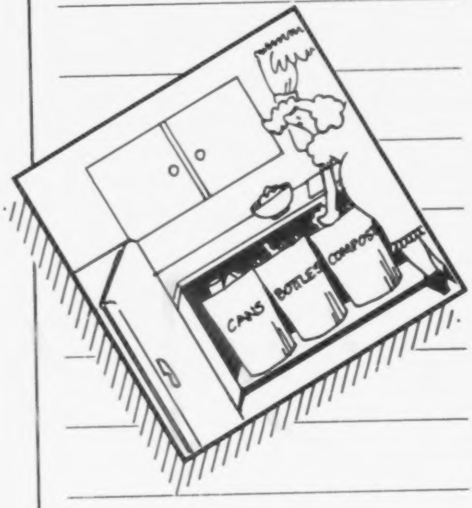
* Adapted from the Oregon Department of Environmental Quality, Solid Waste Division.

RECYCLING

Recycling means using post-consumer materials and products to make new products. Although all sectors of society (domestic, industrial, commercial and institutional) can participate in recycling, the following are some common ways of recycling household waste products:

1. Separate household garbage into the six main groups. The chart entitled *Proper Preperation of Recyclables* presents a more detailed look at how to prepare material for recycling.
2. Deliver recyclable materials to a local recycling facility.
3. Make compost from organic wastes and consider starting a small vegetable garden if space is available.
4. Buy products which contain recycled materials.
5. Take used engine oil to a service station which will recycle it.

To encourage recycling in the home it is helpful to have separate boxes, bags or compartments in which to place the various recyclable materials. Building shelves or spaces for cans, bottles and papers in a closet, cupboard or the basement can be a family project.



HOW TO COMPOST

Compost is often termed "the magic ingredient of the garden." Compost piles provide the best conditions for the decompostion of organic matter into an odourless supply of rich humus.

A good compost pile maintains the optimum conditions to support successive populations of different life forms (e.g. moulds, bacteria, ants, worms, etc.) which thrive in organic matter. At their peak, populations may number more than 10 billion micro-organisms per gram of decaying material. The two main ingredients in maintaining a healthy compost environment are carbon and nitrogen.

Carbon-rich materials include:

— leaves, wood chips, sawdust, hay, straw, pine needles, corn stalks and shredded paper.

Nitrogen-rich materials include:

— household food wastes, grass clippings, weeds, sewage sludge, seaweed, animal manures, bone and blood meal.

Note: meat, scraps, grease, bones, plastics and textiles should *not* be used in a compost because they can inhibit proper decomposition as well as attract rodents, pets and other pests.

Along with organic wastes, compost piles require air, moisture and heat (which is self-generated). Air is introduced by turning the compost every 3 or 4 days. The wastes should not be packed down. If the compost begins to smell, it is an indication that it doesn't have enough air. Keep the compost moist but not soggy as excess water displaces oxygen.

Compost containers can be built from plastic buckets, old garbage cans, metal drums or wooden frames. Successful decomposition requires a container of at least 1 m × 1 m × 1.5 m deep or larger, depending on how much space is available.

For complete details on composting see *Garbage is Resource Full*, which is available from the Information Services Branch of the B.C. Ministry of Environment.

GETTING INVOLVED AT SCHOOL

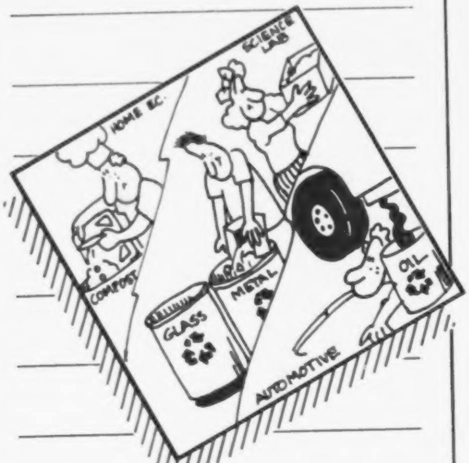
A Canadian high school with 1,200 students discards about 3 tonnes of recoverable paper each year. While there are other resource recovery opportunities in a school, paper collection is probably the best and easiest recycling project to institute. Once paper collection is in progress, the recycling program could be expanded to include other items. Keep in mind that any recycling project has to be designed to meet local market needs for recyclable goods.

Here is a way to start a school paper recycling program:

1. Contact paper buyers to establish if there is a market for the recycled paper. If so, which levels and grades of papers will be purchased?
2. Obtain permission for the project from the school administrator.
3. Recruit a recycling team and a teacher to act as a resource person.
4. Inform the staff and maintenance people about the proposed project and solicit their support.
5. Estimate the quantity of recoverable paper. There are basically two categories of paper for recovery:
   - (a) *Low grade papers* such as lunch bags, newspapers and cardboard boxes. These papers can be identified by their brownish colour or by the presence of tiny wood-like flecks.
   - (b) *High grade papers* which have been bleached to remove the brown colouring.

   Determine how much is high grade and how much is low grade. Ensure that high and low grade papers are collected in separate containers: low grade papers are considered "contaminants" when mixed with high grade papers. Large recycling operations will further sort the high grade papers into four levels:
   - (1) White Ledger — printed white bonds
   - (2) Manifold Coloured Ledger — printed white bonds with 100% coloured bonds
   - (3) Coloured Ledger — printed coloured bonds
   - (4) High grade mixed — clean assortment of various kinds of high grade paper.
6. Determine a method of transporting the paper from the school to the buyer. This may include a rotating list of volunteers with vans or trucks.
7. Get permission to use storage and working space in the school.
8. Design a collection system which keeps the grades of paper separate and, at the same time, encourages participation by teachers, administrators and students.
9. Calculate the estimated costs and revenues to determine if the project is economically sound.
10. Decide how the money earned from the project will be allocated.
11. Go to it!

There are other resources which could be recovered in a school. It may be possible to build a compost box to handle organic wastes from the cafeteria. The compost could then be given away, sold or used in a school gardening project. Glass and metal containers from lunch rooms, cafeterias, science laboratories, maintenance shops and photography clubs could be recycled. Recycling aluminum containers and returnable bottles can be profitable. Another project would be to encourage the industrial education department to repair school equipment and recycle shop wastes. Used automobile oil could be recycled through the "Oil Save" program which is jointly sponsored by industry and the B.C. Ministry of Environment.



Opportunities to recover resources in school are varied. By starting a school project, students and teachers can get into the routine of separating and recovering resources. This may also encourage people to begin similar practices at home.

GETTING INVOLVED IN THE COMMUNITY

Communities in B.C. and elsewhere have instituted a variety of resource recovery programs which include recycling, composting of municipal sludge and energy recovery from wastes.

> The City of Seattle, for example, sponsors a three-step composting program which includes (1) public education regarding backyard composting, (2) allocation of city lots for neighbourhood composting, and (3) inclusion of facilities at recycling centres to handle some organic wastes. Another example is the composting of municipal sludge by the Comox-Strathcona Regional District on Vancouver Island. In Kitchener, Ontario, methane gas produced from the fermentation of wastes in the local landfill is used as a source of energy by a nearby industry.

A more common approach to community resource recovery is the collection of household recyclables. This type of program improves resource use and can eventually save taxpayers money by reducing municipal waste disposal costs. The two main systems of community recycling are: (1) *curbside collection*, in which householders separate recyclable materials at home, place them at curbside on designated days, to be picked up and delivered to a recycling depot; and (2) *recycling centre programs*, in which householders separate recyclables at home and deliver them to the recycling centre. Curbside collection programs are more convenient for householders (and thus characterized by higher participation rates) but more costly to operate, while recycling centre programs are less convenient (and therefore characterized by lower participation rates) but less expensive to run.

CURBSIDE COLLECTION

Two major types of curbside collection programs exist.

1. *Curbside Source Separated Pick-up*
   This is usually the most expensive and difficult type of program to operate. Paper, glass and metal are separated by the householder, picked up at curbside and placed in separate compartments on a truck. The materials are further sorted at the recycling centre: paper and metals by type, glass by colour. Because it is inconvenient for many householders to separate their waste materials, community participation in such programs has generally not been high enough to justify the cost of this type of program. Canada's second largest program of this type is operating in the Municipality of Saanich on Vancouver Island.

2. *Curbside Paper Pickup*
   The *Newspaper Curbside Collection Program* in West and North Vancouver has been very successful. Householders are given blue bags for convenience and to remind them to recycle paper. The bags provide written instructions to place only newspapers, flyers or other forms of newsprint into them. They're picked up at the curb on the usual garbage days.

Recycling Case Study

In 1982, the District of West Vancouver, the District of North Vancouver, and the City of North Vancouver initiated a joint recycling program. The objective was to integrate curbside collection of recyclables with regular garbage collection without subsidizing the cost of recycling. After experimenting with a number of systems, a curbside paper collection program proposed by International Paper Industries (IPI) was selected.

The IPI program works like this:

1. Blue plastic bags are provided to make it convenient for people to separate paper from other garbage.
2. Participants are instructed to place the paper-filled bags outside, along with the rest of the garbage on collection day.
3. IPI uses its own trucks to pick up recycled paper on the same day that regular trash collection is scheduled.
4. There is no direct cost to the taxpayers.
5. The communities, through the mayors' offices, provide promotional and public relations support.
6. Recycling depots for glass, metal, oil, and paper were established.

International Paper Industries is well integrated in the paper production industry. It collects, sorts, grades, bales and sells or uses the recycled paper in its Hong Kong plant for production of new paper products. Over the course of one year, IPI collects about 4000 tonnes of paper through the curbside collection program. This saves the districts and municipality almost $75,000 in annual disposal costs. Public participation rates are high: approximately 65% of the newsprint from the 50 000 households from Horseshoe Bay to Deep Cove are collected at curbside.

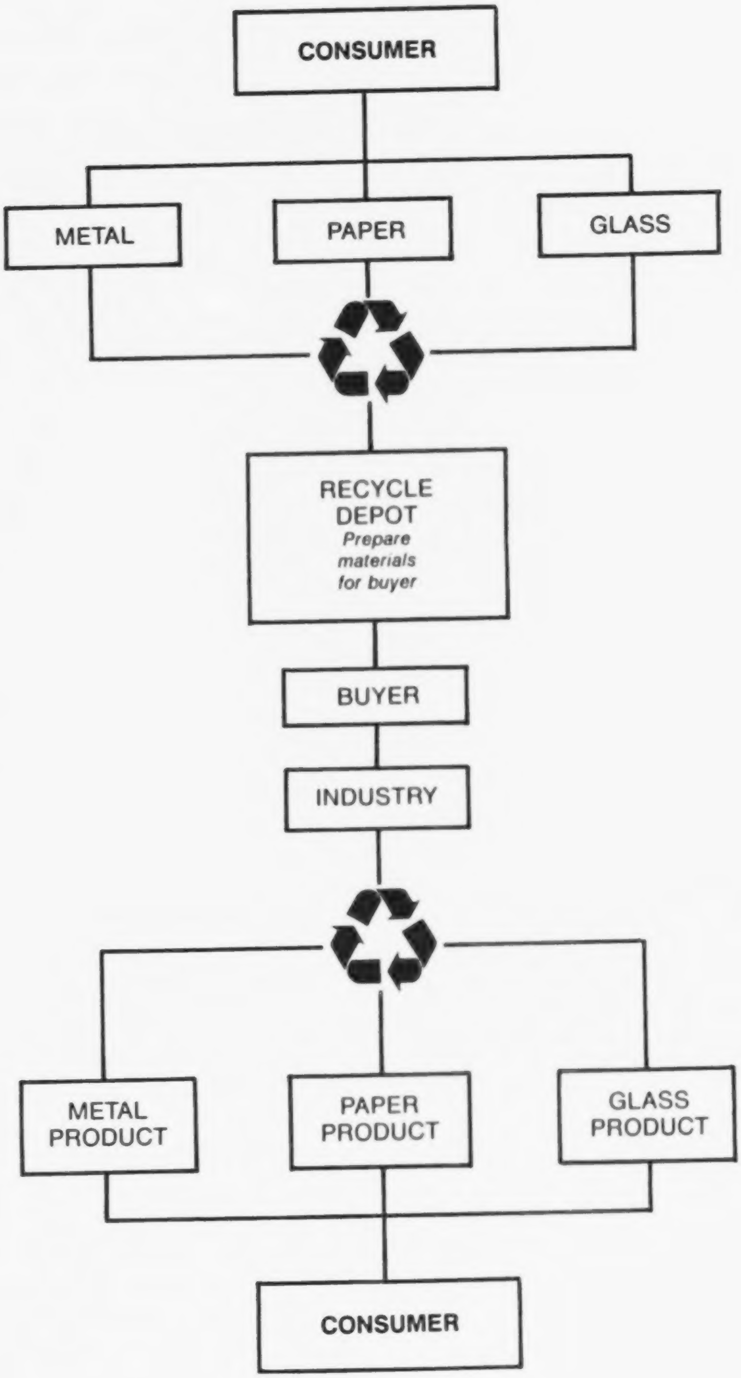
Since this program is operated by a broker of the recycled product, some of the problems which have plagued other recycling projects have been eliminated. There is a *guaranteed market* for the paper and the end-user is assured of a *stable supply*. Also, because IPI is involved with all aspects of paper recycling, the program's administrative and transportation costs are reduced.

The IPI program provides an example of how the community, local governments, and industry can cooperate to implement a recycling program. While the program does not yet pay for itself, it has excellent prospects for long term success.

Curbside recycling programs can pay for themselves if they are organized carefully. If economically feasible, a program should be designed to collect newspapers, glass and metals separately. But because they require large investments in equipment and labour, fluctuating prices or insufficient community participation can make them unprofitable. Public education is essential to ensure community participation, which will in turn guarantee stable prices and steady supplies of recyclables.

One way to bolster community participation is to inform community groups, politicians and businessmen of your support for recycling wastes. This can be accomplished by writing letters in support of increased involvement in recyling. (Where possible, encourage the publishing of articles and reports about successful recycling initiatives in other areas.)

A RECYCLING SYSTEM



In addition, people can get involved in the education process by speaking directly to their friends or by inviting waste management experts to make presentations to school classes, community groups or representatives of the media.

Public education is important: it is difficult to recover many resources from domestic wastes when they are combined with the recyclable components (e.g. glass, paper and metal) with other household wastes. Once those resources are mixed together, large amounts of money must be spent to separate or dump them. If the recyclable resources are separated from the rest of the household garbage at the source, the amount of garbage produced, and the cost of handling it, are reduced.

COMMUNITY RECYCLING CENTRES

Once householders have delivered their separated glass, paper and metals to the recycling centre, further sorting is required. For example: glass is sorted by colour; paper is sorted into cardboard, fine paper and newsprint; metals are sorted by type (aluminum, tin, steel, etc.) All materials must be clean, free of contamination (i.e. no wrappers or labels on cans, no metals tops or collars on bottles, etc.) and tin cans must be flattened.

The materials are sorted into bins and transported directly to processors. Simple operation makes depots relatively inexpensive. But, it is not as convenient for the householder. Many community recycling depots are constantly struggling to break even because of low participation rates. The accompanying chart shows the flow of materials in the recycling operation of the Capital Regional District on Vancouver Island.

If greater use was made of recycled materials, the market for recyclables would improve. An increased demand for recyclable materials would lead to higher prices for them which, in turn, would encourage more individuals, municipalities and industries to recycle. Buyers of recyclable materials cannot promise a stable price for used newspapers, glass or aluminum cans unless municipalities are prepared to guarantee a steady supply of materials. On the other hand, municipalities are reluctant to spend money on an integrated resource recovery system until they can be assured they will receive a firm and reasonable price.

The key to successful recycling is involvement on a number of levels. There is a multitude of jobs to be done. Markets have to be explored, systems have to be designed and centre start-ups have to be planned and financed.

If you decide to get involved in your home, school or your community, you *can* make a difference.

Module Eight Terms

compost
curbside collection
guaranteed market
high grade papers
low grade papers
recycle
recycling centre program
reduce
reuse
source reduction
stable supply

NOTES

MODULE #8 — QUESTIONS, PROJECTS AND ACTIVITIES

1. Define the following terms:
   (a) source reduction
   (b) low grade paper
   (c) high grade paper
   (d) curbside collection
   (e) recycling centre programs
2. Identify at least five ways of accomplishing each of the following in your home:
   (a) reducing waste
   (b) reusing waste
   (c) recycling waste
3. Investigate the possibility of starting a paper recycling program in your school. Refer to the section in the text which outlines how to start a school recycling program.
   (a) Estimate the quantity and type of paper that is recoverable.
   (b) Determine if there is a market for the school's waste paper.
   (c) Calculate the estimated costs of operation and revenues generated by a school recycling program.
   (d) If the project looks feasible, discuss the possibility of establishing a paper recycling program with school officials.

NOTE — (Optional project for a computer whiz.) Develop a computer program that would assist your classmates in making decisions regarding the following:
   (1) materials management at the recycling site.
   (2) work schedules during the hours of operations at the recycling site.
   (3) the business finances of running the recycling project.

4. Investigate a local or regional recycling facility and make a report to the class regarding:
   (a) How the facility operates. What materials are recycled and where they go?
   (b) How to prepare paper, metal, glass, oil and food and garden wastes for recycling.
5. Obtain a copy of *Garbage is Resource Full* (or another publication) and read the section that contains detailed instructions on how to start a compost pile.
   (a) Using grass clippings, manure, weeds, hay, sawdust, coffee grinds and other similar wastes, construct 5 small experimental compost piles as follows: (Make sure not to include bones, meat, grease or other material that may attact rodents and other pests.) Each pile should contain approximately one cubic metre of material when first constructed, or if necessary, use 22-litre buckets with holes drilled in the sides.

      #1 (This pile will be low in nitrogen)
      — no manure or garbage that is high in nitrogen
      — moisten, don't soak
      — turn over regularly, every 3–4 days at first, then once a week
      — include a mixture of ingredients

      #2 (This pile will not have enough moisture)
      — include manure, garbage and other contents which are high in nitrogen (manure and blood meal are high in nitrogen)
      — turn the compost regularly
      — include a good mixture of ingredients
      — don't water at all and don't include any garbage which has a lot of moisture in it

#3 (This pile will lack proper air circulation)
- include manure, garbage and other contents which are high in nitrogen
- include a good mixture of ingredients
- moisten, don't soak
- do *not* turn the compost

#4 (This pile is composed of too much of a single ingredient)
- put only leaves or grass clippings in this pile
- moisten, don't soak
- turn the compost regularly

#5 (This is a good compost pile)
- include manure, garbage and other contents which are high in nitrogen
- moisten, don't soak
- turn the compost regularly
- include a good mix of ingredients which are layered

(b) Predict what will happen in each case and give reasons for your predictions.

(c) Observe and record the temperature of each compost pile on a daily basis. Observe and record the condition of each compost pile on a weekly basis.

(d) Compare the results with your predictions.

(e) How is composting related to recycling?

6. Design a kitchen that will make it easy for a family to recycle their wastes. Will you need to invent any special items for the "recycling" kitchen? If so, what are they?

7. **This is a teacher directed activity** — If there is a recycling operation in your area, call the administration office and inquire about a tour. If a tour isn't possible, arrange for a speaker to come to class. Before the tour or lecture, it is important to:

   (a) Discuss all phases of the recycling process, particularly as it relates to the local area.

   (b) Arrange to have the tour or lecture follow the recycling process in sequence if at all possible.

   (c) Assign each student, or group of students, specific tasks to be completed during, or immediately following, the tour or lecture.

   (d) In the case of the tour, stress the importance of safety at all times.

NOTES